Review of Exceptional Event Request

Maricopa County, AZ

24-Hour PM_{10}

- March 14, 2008
- April 30, 2008
- May 21, 2008
- June 4, 2008

U.S. Environmental Protection Agency
Region 9

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1.0 Introduction

On March 22, 2007, EPA adopted the *Treatment of Data Influenced by Exceptional Events*,[1] also known as the Exceptional Events Rule (EER), to govern the review and handling of certain air quality monitoring data for which the normal planning and regulatory processes are not appropriate. Under the terms of the EER, a state may request EPA to exclude data showing exceedances or violations of the National Ambient Air Quality Standard (NAAQS) that are directly due to an exceptional event from use in determinations by demonstrating to EPA's satisfaction that such event caused a specific air pollution concentration at a particular air quality monitoring location.[2] Before EPA will exclude data from these regulatory determinations, the state must flag the data in EPA's AQS database and, after notice and an opportunity for public comment, submit a demonstration to justify the exclusion. After considering the weight of evidence provided, EPA will determine if the demonstration satisfies all the requirements of the EER and either concur or nonconcur with the state's request.

On June 30, 2009, the Arizona Department of Environmental Quality (ADEQ) submitted to EPA a preliminary demonstration for exceedances that occurred at various monitoring locations throughout Arizona on 27 separate days in 2008, including five at the West 43rd monitoring site located in southwestern Phoenix. On November 17, 2009 ADEQ submitted final demonstrations for twelve of these exceedances, including five at the West 43rd site.[3]

This document sets forth the legal and factual basis for EPA's decision regarding four exceedances of the 24-hour PM_{10} NAAQS in 2008 at the West 43rd monitoring site on March 14, April 30, May 21, and June 4, 2008 that ADEQ has flagged as "high wind" exceptional events.[4] EPA has not yet completed its analysis of the remaining dates and is not making a concurrence or non-concurrence determination for them at this time.

The documentation submitted by ADEQ and considered by EPA in support of the exceptional events claims includes the following:

- Assessment of Qualification for Treatment under the Arizona Natural and Exceptional Events Policy for the High Particulate (PM_{10}) Concentration Events in the Phoenix Area on March 14, 2008 (March 14 Assessment);
- Assessment of Qualification for Treatment under the Arizona Natural and Exceptional Events Policy for the High Particulate (PM_{10}) Concentration Events in the Phoenix Area on April 30, 2008 (April 30 Assessment);

[1] 72 FR 13560-13581, March 22, 2007.
[2] 40 CFR §50.14 (a).
[3] On March 17, 2010 EPA received a draft-supplemental report titled "Assessment of Qualification for Treatment Under the Federal Exceptional Events Rule: High Particulate (PM_{10}) Concentration Events in the Phoenix and Yuma Areas on June 4th, 2008." Information presented in this document will be considered in EPA's concurrence/non-concurrence decision for the claimed event that occurred on June 4, 2008. EPA has not received additional information concerning the other three events we are reviewing in this document.
[4] The West 43rd monitor also measured a fifth exceedance on November 9, 2008; EPA is not reviewing this event at this time.

- Assessment of Qualification for Treatment under the Arizona Natural and Exceptional Events Policy for the High Particulate (PM_{10}) Concentration Events in the Phoenix Area on May 21, 2008 (May 21 Assessment);
- Assessment of Qualification for Treatment under the Arizona Natural and Exceptional Events Policy for the High Particulate (PM_{10}) Concentration Events in the Phoenix Area on June 4, 2008 (June 4 Assessment);
- The Impact of Exceptional Events "Unusual Winds" on PM_{10} Concentrations in Arizona (Unusual Winds White Paper);
- High Wind Exceptional Events and Control Measures for PM_{10} Areas (Controls White Paper); and
- DRAFT – Supplemental Report: Assessment of Qualification for Treatment under the Federal Exceptional Events Rule: High Particulate (PM_{10}) Concentration Events in the Phoenix and Yuma Areas on June 4, 2008 (June 4 DSR).

2.0 Summary of the Events

In 2008, there were seventeen PM_{10} monitoring sites operating in Maricopa County, ten of which use continuous PM_{10} analyzers that produce hourly data. During 2008, the West 43rd monitoring site, which measures PM_{10} with a continuous analyzer,[5] measured five exceedances of the 24-hour PM_{10} NAAQS, four of which are reviewed in this document.[6] ADEQ has claimed that the exceedances at the West 43rd site resulted from the transport of dust from soils by high winds, the high wind event was a regional phenomenon that affected the entire Phoenix area, and the events were the result of the transport of dust and soils from high winds that suspended natural soils and soils from areas where BACM was in place.[7]

Table 1: West 43rd 2008 PM_{10} Exceedances

Date	PM_{10} (ug/m^3)	Weather Condition	Wind Direction
March 14	251	Low Pressure Trough	W
April 30	173	Frontal System Passage	WSW
May 21	279	Frontal System Passage	W
June 4	194	Frontal System Passage	WSW

3.0 Requirements of the Exceptional Events Rule

Pursuant to 40 CFR §50.14(c)(3)(iii) a request for EPA's concurrence on an exceptional event flag must be accompanied by a demonstration that:

(A) The event satisfies the criteria set forth in 40 CFR §50.1(j) that it:
1. affects air quality;
2. is not reasonably controllable or preventable;

[5] All of the continuous analyzers in Maricopa County, including the analyzer at West 43rd, are Thermo Scientific TEOM 1400AB analyzers with EPA FEM designation number EQPM-1090-079.
[6] EPA is not analyzing the exceedance on November 9, 2008 at this time.
[7] March 14, April 30, May 21, and June 4 Assessments at p.4.

3. is caused by human activity that is unlikely to recur at a particular location, or is a natural event;
4. does not include stagnation of air masses or meteorological inversions, a meteorological event involving high temperatures or lack of precipitation, or pollution relating to source noncompliance;

(B) There is a clear causal relationship between the measurement under consideration and the event that is claimed to have affected the air quality in the area;

(C) The event is associated with a measured concentration in excess of normal historical fluctuations, including background; and

(D) There would have been no exceedance or violation but for the event.

The demonstrations must fully meet all the above criteria to EPA's satisfaction; failure to meet any one of the criteria will result in the non-concurrence of the event in question.. In addition to the technical criteria, the EER also has procedural requirements. 40 CFR §50.14(c)(2)(iii) requires that data claimed to be due to an exceptional event must be flagged in the AQS database, and that an initial description of the event be provided to EPA; both must occur by July 1 of the year following the event. In addition, 40 CFR §50.14(c)(3)(i) requires that the State:

- submit a demonstration to EPA within three years of the calendar quarter of the event or 12 months prior to an EPA regulatory decision;
- provide notice and opportunity for public comment; and
- submit any public comments along with the demonstration.

EPA's concurrence or non-concurrence with a State's flag constitutes its agreement or disagreement with the State on whether the data should be excluded from regulatory decisions involving a State's compliance with the NAAQS. EPA's determination regarding a State's attainment status or action on a state SIP submission will be issued in a rulemaking which is a final agency action that is judicially reviewable under CAA section 307(b)(1).

The following sections evaluate ADEQ's assessments of March 14, April 30, May 21, and June 4, 2008 with respect to these requirements.

4.0 Criteria Set Forth in 40 CFR §50.1(j)

4.1 Affect Air Quality

As stated in the preamble to the EER, the event in question shall be considered to have affected air quality if it can be shown that there is a clear causal relationship between the monitored exceedance and the event (section 5.0), and that the event is associated with a measured concentration in excess of normal historical fluctuations (section 6.0).[8]

[8] 72 FR 13569, 72 FR 49051, and 73 FR 14702.

4.2 Reasonably Controllable or Preventable

A determination of whether a particular event was "not reasonably controllable or preventable" depends on the specific facts and circumstances surrounding the event. Therefore, EPA addresses this and the other criteria of the EER on a case by case basis.

This factor of the analysis should consider whether anthropogenic sources contributing to the exceedance caused by the event were reasonably controlled.[9] ADEQ's supporting documentation, however, did not specifically identify the type or location of the possible contributing sources in the area, other than the Salt and Gila River channels, located upwind of the West 43rd monitoring site.. Although the June 4 DSR identifies that the alluvial channels located upwind of the West 43rd monitor most likely significantly contributed to the exceedance at West 43rd site, ADEQ did not evaluate whether emissions from those sources were reasonably controllable or preventable.

The June 4 DSR included a table titled, "Rules Regulating Particulate Matter Emissions in Maricopa County," which includes the rule number, title, and a brief description of the general sources that the rule is designed to control. Without addressing the types, and locations of sources in the area, however, it is not possible to evaluate whether sources in the area were reasonably controlled.

4.3 Human Activity/Natural Event

The term "natural event" is defined at 40 CFR §50.1(k) as "an event in which human activity plays little or no direct causal role." As described in the preamble to the EER, high wind events may qualify as exceptional events if the following conditions are met: the wind speed associated with the event is "unusual for the affected area during the time of year that the event occurred," and, in instances where wind produces emissions from anthropogenic sources, all reasonable and appropriate measures must be in place for all contributing sources.[10] An event that was caused by human activity, but is unlikely to recur at a given location may be considered an exceptional event assuming all other requirements of the rule are met.

ADEQ's Assessments briefly discussed the various source categories in the area, including industrial sources, construction, area sources (unpaved parking lots and shoulders), roads, track out, and windblown dust. According to ADEQ, the windblown dust category includes significant contribution from the following sources: agriculture, alluvial channels, vacant lots, construction, industrial, disturbed areas, and stockpiles. In addition, EPA has identified, through satellite images and visits to the area, numerous anthropogenic sources in the area that could contribute to elevated PM_{10} concentrations. The commercial nature associated with many of these activities indicates that some portion of them can be reasonably expected to recur.

To establish that the exceedances at the West 43rd site may properly be classified as "natural events," the data must support a finding that "human activity plays little or no direct causal

[9] EER Preamble, 72 FR 13566, n. 11.
[10] EER Preamble, 72 FR 13566.

role."[11] ADEQ's Assessments of the four exceedances did not analyze potential contribution from anthropogenic sources. The Controls White Paper states that because of "the relative complexity of the emitting source mix, parsing out a specific source or source category along with the applicable control measures for a determination of relative effectiveness can be difficult and may even be counter-productive." ADEQ's Assessments also stated that "no specific emission allocation is possible based on the data for analysis" and that "the primary source appears to be wind-blown dust over central Arizona for which there is not an effective or efficient method to estimate the relative contributions from specific sources."[12]

The lack of analysis regarding anthropogenic contribution upwind of the West 43rd site makes it difficult to determine the contributing role of human activity to the exceedances at the West 43rd site, particularly where it is known that commercial activities such as agriculture, sand and gravel mining and construction are known to take place.

EPA notes that the EER did not set a specific threshold to define a "high wind event,"[13] but suggested the use of a comparison of wind speeds measured on the event day to be compared to historical wind speed levels "for the season of the year that the event occurred."[14] The analysis that supports ADEQ's definition of "unusual" wind was based on data from 2005 through 2009 for the entire year period and was only analyzed for four monitoring sites (Buckeye, West 43rd, Durango Complex, and Higley). The use of a complete year of data in this situation rather than the season during which the events occurred likely biases the statistical analysis low. The Phoenix area experiences more consistent elevated wind speed levels associated with frontal passages during the months of March through June.

Conclusions drawn from this analysis suggest that wind speeds that occur less than 5% of the time should be considered "unusual" for exceptional events purposes. For the West 43rd monitoring station, this standard would correspond to sustained hourly wind speeds greater than 10 mph and wind gusts[15] greater than 20 mph. ADEQ's documentation did not provide any specific analysis pertaining to certain hours of the day and there is no discussion of the wind speeds that are associated with the event and their relationship to the 95th percentile. While wind speeds above the 95th percentile may seem unusual, the frequency of occurrence of hourly wind speeds over 10 mph at this site is approximately 100 days per year.[16]

The Unusual Winds White Paper further stated that "unusual winds can be defined as any wind that has the ability to create windblown dust." ADEQ's definition could be interpreted to treat all windblown PM_{10} as exceptional as long as the wind speeds are about the threshold friction velocity for that area. Threshold wind speeds provide a minimum baseline for wind speeds that are capable of producing windblown dust and are based on particle interaction on the ground surface, while "high" and "unusual" wind speed definitions should be based on a separate analysis. Thus, although this evidence may contribute to the exceptional analysis, it should not

[11] 40 CFR §50.1(k)
[12] March 14, April 30, May 21, and June 4 Assessments at p.4.
[13] EER Preamble 72 FR 13577.
[14] Id. at 13566.
[15] Wind gusts from Maricopa County stations are 1-sec maximum wind speed value for the hour.
[16] Based on data from 2007-2009.

be a major deciding factor when determining whether wind speed associated with an exceptional event is "unusual."

In summary, considering the limited analysis on the elevated wind speeds associated with the event combined with little analysis of possible contributing sources located directly upwind of the West 43rd site, EPA has determined that ADEQ's documentation did not provide sufficient evidence to support that the events in question should be considered "natural events" as required under the EER.

4.4 Stagnation of Air Masses/Inversions/High Temperature/Lack of Precipitation/Source Noncompliance

ADEQ did not provide any evidence suggesting that the exceedances at the West 43rd monitoring site were the direct result of stagnation of air masses, inversions, high temperature, or lack of precipitation. Regarding source noncompliance, ADEQ states that, "no local sources were reported as significantly contributing to the air quality episode" for all days except June 4. This statement assumes that because there were no observations made (i.e. there were no reported civilian complaints or enforcement actions), that all sources in the area were in compliance with all applicable fugitive dust control measures.

The June 4 assessment explained that there were two Notice of Violations (NOV) issued on June 4 and June 5 for noncompliance with Maricopa County's (MCAQD) fugitive dust rules. The June 4 DSR also states that "one complaint based inspection of a dust control permit on June 4… resulted in a Notice of Violation (NOV) for track-out under Rule 310" and on June 5 "an inspection of a Rule 316 source resulted in the issuance of a notice of violation for failure to install a wheel washer." Both of the NOVs were issued to sources that are located within a two mile radius of the West 43rd monitoring site, but the specific locations of these facilities were not identified in the June 4 assessment or DSR. The NOVs provide some evidence that nearby sources may not have been reasonably controlled during the time of the event.

5.0 Clear Causal Relationship

In order for EPA to concur with an exceptional event request, the EER requires the State to demonstrate that there is a clear causal relationship between the measurement under consideration and the event that is claimed to have affected air quality in the area. 40 CFR §50.14(a)(2); 40 CFR §50.14(c)(3)(iii). To address this element for "high wind events," such as those flagged by Arizona, the state should reasonably consider the relationship between an event, the PM_{10} emissions caused by unusually high winds, and a measured exceedance at a monitoring site. Arizona's Assessments included various data points relevant to this analysis. EPA's technical review also considered additional data regarding wind speed and direction, PM_{10} concentration, and visibility.[17]

As a preliminary matter relevant to this issue, EPA notes that ADEQ's limited analysis of the potential sources that might have contributed to the exceedances at the West 43rd site (sections

[17] Appendix A contains pollution roses based on % total PM_{10} mass for all four of the events in question.

4.2 and 4.3) makes it difficult to comprehensively evaluate the causal relationship between the event and the exceedance. Another general point concerns the data provided by Arizona for each event. EPA notes that, for each of the four events reviewed in this document, Arizona provided different sets of PM_{10} data drawn from among the ten monitoring stations using continuous analyzers. EPA also notes that Arizona provided a different set of meteorological data for each event. Considering the four events discussed in this document are very similar in nature, it is unclear why ADEQ did not provide the same data for each event. In some instances the most relevant meteorological data, (those data from the closest or upwind locations) are not included in the supporting documentation.[18]

5.1 March 14, 2008

5.1.1 Correlation between Wind Speed and PM_{10}

The March 14 Assessment included tabular hourly and maximum wind speed and PM_{10} data for five monitoring sites in the Phoenix area: West 43rd, Durango Complex, West Phoenix, Coyote Lakes, and Central Phoenix. ADEQ also included meteorological data from three National Weather Service (NWS) stations: Goodyear Airport, Glendale Airport, and Phoenix Sky Harbor.[19] EPA notes that ADEQ did not provide hourly PM_{10} data from the other four continuous PM_{10} analyzers in the Phoenix area and did not include wind speed and direction data from numerous other meteorological stations in the Phoenix area.

ADEQ also provided four graphs that show the potential correlation between maximum wind speeds and PM_{10} concentrations at the West 43rd, Durango Complex, Greenwood, and South Phoenix monitoring sites. [20] The graphs show that hourly PM_{10} concentrations increase with an increase in maximum recorded wind speed at the West 43rd site, but not at the other three monitoring sites. In fact, the graphs show that the maximum wind speeds at the Durango Complex site were higher than those measured at the West 43rd site, but the Durango Complex site experienced significantly lower PM_{10} values during periods of elevated wind speed. These data suggest that the elevated PM_{10} concentrations at the West 43rd site may have been caused by local upwind sources and were not due to a high wind event that was regional in nature.

5.1.2 Visibility

The March 14, Assessment included photographs from numerous locations throughout the Phoenix area. Unfortunately, there is not a significant discernable difference between the conditions preceding and during the event. Therefore, the photographs do not significantly

[18] Table 1 in Appendix A identifies the PM_{10} and meteorological stations ADEQ used in their analysis of the 2008 exceptional events in question.

[19] ADEQ also included meteorological data from two AZMET stations. These data are collected at 3 meters, while NWS and Maricopa County data are collected at 10 meters. There does not seem to be any correction or adjustment for the difference in the heights of these stations.

[20] The max wind speed values used in this comparison are the instantaneous max wind speed values recorded by onsite data loggers, which have the capability of recording these instantaneous values in a fraction of a second. ADEQ does not explain why the use of the maximum 1-sec value for an hour is the appropriate measure for comparison to hourly average PM_{10} values.

contribute to establishing a causal relationship between wind speed, potential contributing sources, and PM_{10} concentrations at the West 43rd site.

The March 14 Assessement also stated that reduced visibility during the event throughout portions of the Phoenix provides further evidence of a clear causal relationship between the high wind event and the measured exceedance at the West 43rd site. The visibility at Goodyear Airport before the event ranged from 60 to 20 statute miles, while during the time of the elevated PM_{10} concentrations at West 43rd the visibility ranged from 15 to 10 miles. Other NWS stations in the area did not record any decrease in visibility throughout the entire day: visibility at Glendale Airport remained at 20 miles, Sky Harbor remained at 10 miles, and Luke Air Force Base remained at 10 miles. Visibility throughout the day in the Phoenix area was never significantly reduced; thus, this information does not significantly contribute to establishing a clear causal relationship.[21]

5.1.3 Review of 24-Hour PM_{10} Data

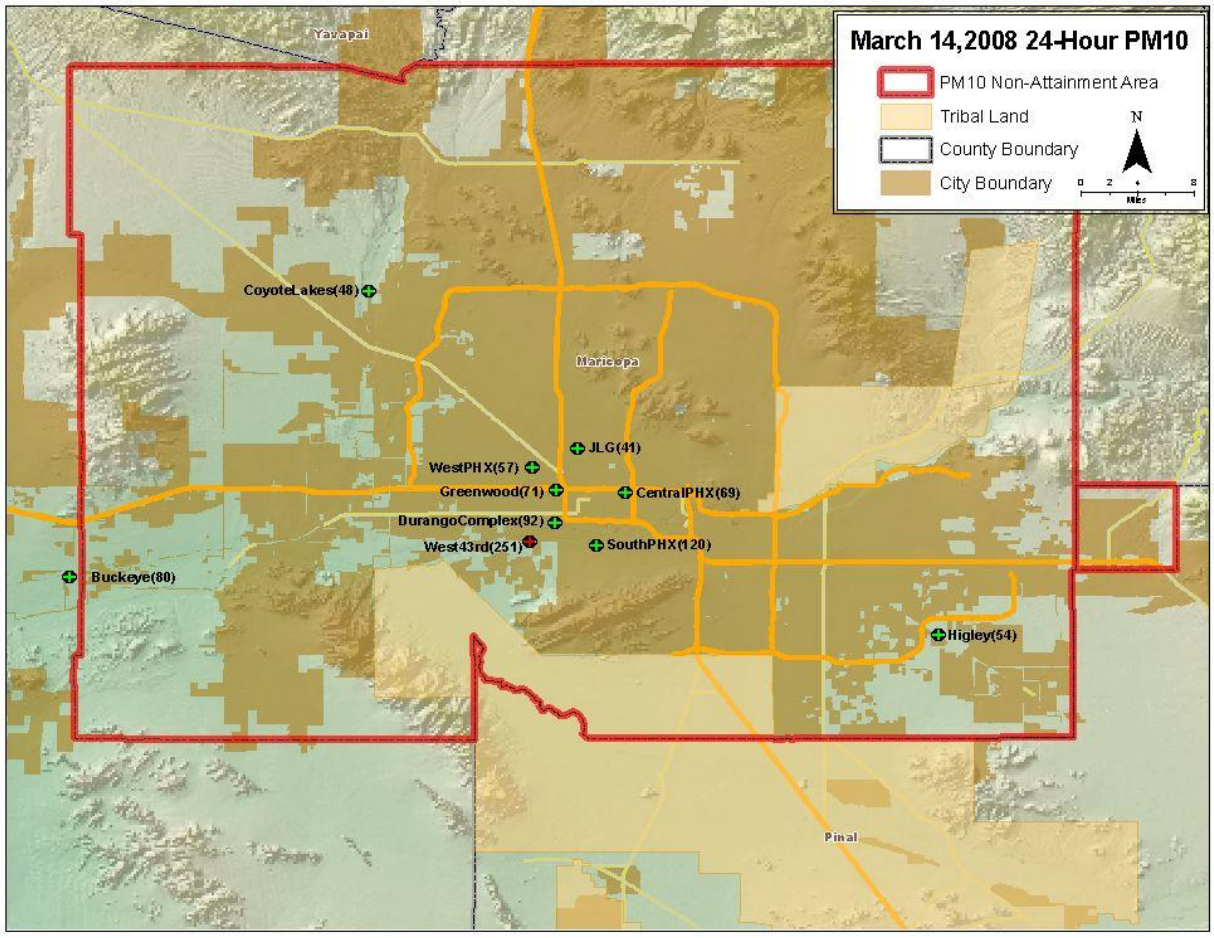
The 24-hour PM_{10} concentrations measured on March 14 at the West 43rd and surrounding sites are listed in Table 2 and shown in Figure 1. On this day, the West 43rd site was the only site in the Phoenix area to exceed the 24-hour PM_{10} standard. Furthermore, PM_{10} concentrations at the West 43rd site were 2-3 times higher than those measured at other sites, which is generally inconsistent with the notion that a regional high wind event caused the exceedance.[22]

Table 2: March 14, 2008 24-Hour PM_{10}

Site Name	**PM_{10} (ug/m3)**	**Site Name**	**PM_{10} (ug/m3)**
Buckeye[23]	80	West PHX	57
West 43rd	251	Central PHX	69
Durango Complex	92	JLG Supersite	41
South PHX	120	Higley	54
Greenwood	71	Coyote Lakes	48

[21] Appendix B contains information pertaining to reduced visibility and dust storms in Arizona.
[22] The only other exceedance recorded in Arizona on March 14, 2008, was the Cowtown monitoring site in Pinal County, which was not flagged as an exceptional event.
[23] 24-hour PM_{10} data for this site was not included in Arizona's Assessment.

Figure 1: March 14, 2008 24-Hour PM_{10}



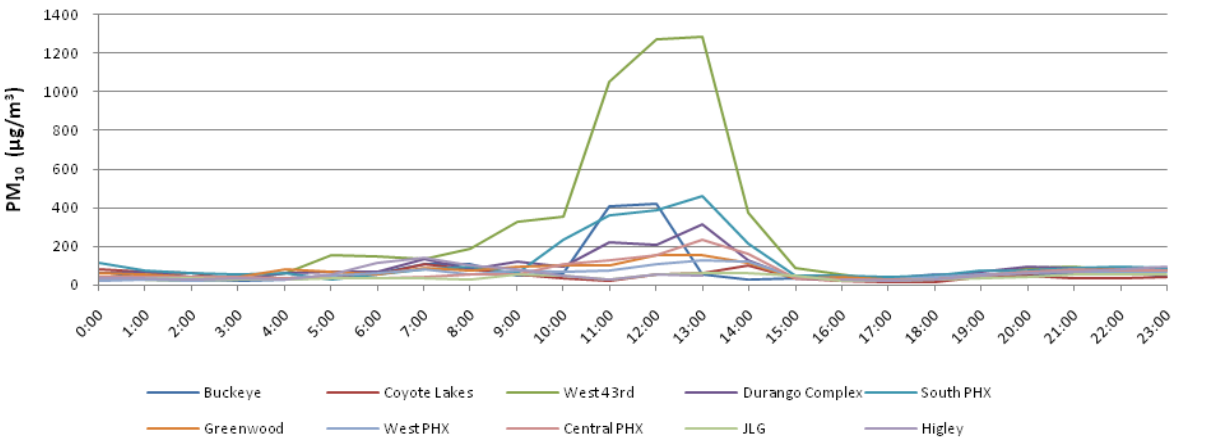
5.1.4 Review of Hourly PM_{10} and Meteorological Data

The hourly PM_{10} data are shown in Figure 2. As early at 0500 hrs, the West 43rd site began to experience an increase in PM_{10} concentration that was not characteristic of the other nine monitoring sites in the Phoenix area. From 0500 to 1000 hrs, the hourly PM_{10} values increased from 150 µg/m^3 to 360 µg/m^3. During these hours the hourly wind speeds throughout the Phoenix area remained below 9 mph, which suggests these elevated concentrations were not driven by high wind, but by some other mechanism. Thus, the elevated PM_{10} during these hours do not appear to have been caused by elevated wind conditions.

The first sign of any elevated winds occurred at the majority of the stations around 1100 hrs. NWS data for Goodyear Airport showed an increase in wind speed from 6 to 14 mph (accompanied by a 29 mph gust); while an increase in hourly wind speed from 12 to 15.9 mph was recorded at the West 43rd site. At 1100 hrs, the PM_{10} concentration at the West 43rd site also rose from 355 to 1051 µg/m^3 and continued to increase over the next two hours to a maximum hourly concentration of 1286 µg/m^3. While the values at some of the other sites in the area increased over the same time period, the values at the West 43rd site ranged from 3-20 times higher than other sites in the Phoenix area. Given that the Durango Complex, South Phoenix,

Greenwood, and West Phoenix sites are located within approximately five miles of the West 43rd site, one would expect to see greater consistency in the PM_{10} concentrations if a regional high wind event was occurring. It is also worth noting that the West 43rd site came close to reaching the peak concentration seen by other nearby sites well before the arrival of elevated wind speeds. The closest site, Durango Complex, reached a maximum concentration of 310 µg/m^3 at 1300 hrs, while West 43rd exceeded this level at 0900 hrs. The inconsistency in the PM_{10} concentrations during the period from 1100 to 1400 hrs and the relatively low wind speeds in the morning hours suggest that the West 43rd site was most likely significantly influenced by local upwind sources and the claimed exceptional event was not regional in nature.

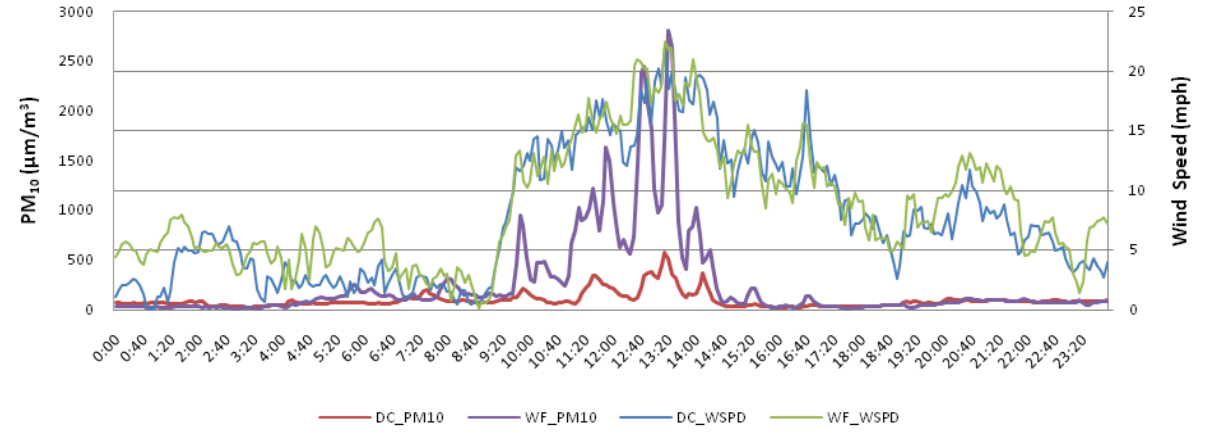
Figure 2: March 14, 2008 Hourly PM_{10}



5.1.5 Review of 5-Min PM_{10} and Wind Speed Data

The 5-min data reinforce the fact that even though elevated wind speeds were measured at other nearby locations, the West 43rd monitor consistently measured much higher PM_{10} concentrations than other locations. Figure 3 shows the 5- min PM_{10} and wind speed data from West 43rd and Durango Complex monitoring sites. These monitors are located only 2 miles apart, yet there seems to be a considerable difference in the relationship between PM_{10} and wind speed on March 14. Both sites experience similar wind speed levels, but during some periods of the day the 5-min PM_{10} concentrations at the West 43rd site were more than five times those measured at Durango Complex. These data provide further evidence that the claimed regional high wind event only affected PM_{10} concentrations at the West 43rd site and the elevated PM_{10} concentrations measured at this site were most likely significantly influenced by local sources and the claimed exceptional event was not regional in nature.

Figure 3: March 14, 2008 5-Min PM_{10} and Wind Speed



5.1.6 Days with Similar Meteorological Conditions

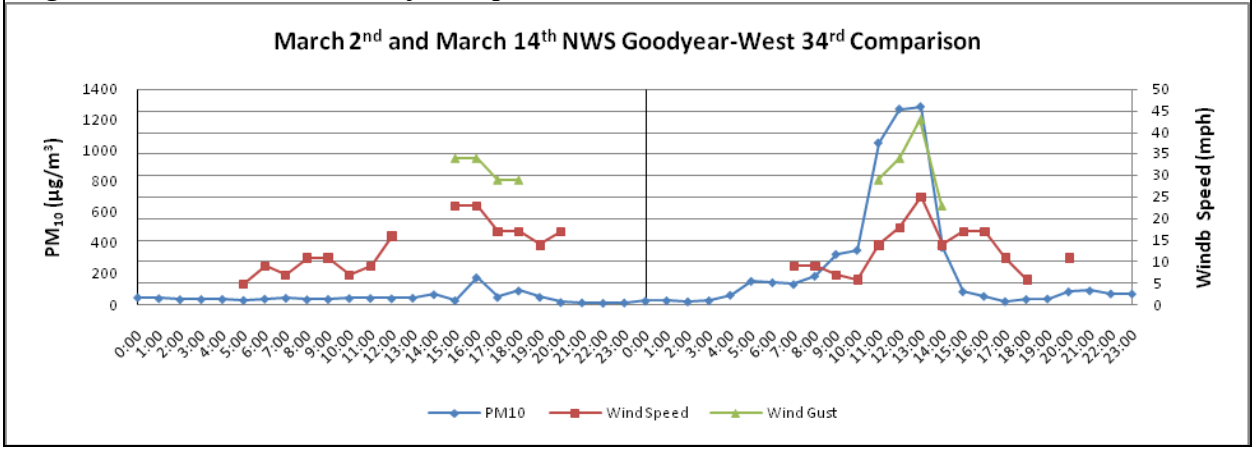
The following discussion emphasizes that meteorological conditions in upwind locations do not always affect on PM_{10} concentrations at the West 43rd site. The NWS station at Goodyear Airport is located approximately 13 miles to the west of the West 43rd monitoring site and serves as the closest location with readily available meteorological data for the area directly to the west of the West 43rd monitoring site.[24]

Wind speeds at Goodyear Airport exceeded 15 mph on ten days in March 2008. On six of those days, wind gusts exceeded 25 mph. Despite these facts, March 14 was the only day in the month of March that measured an exceedance of the 24-hour PM_{10} NAAQS. The following analysis compares hourly PM_{10} data, wind speed, and wind gusts recorded at Goodyear Airport on March 14 with the same data for three days in March with similar meteorological conditions.

On March 14, the West 43rd monitor measured elevated PM_{10} concentrations of 1051 µg/m^3 and 1270 µg/m^3 at 1100 and 1200 hrs, respectively. Wind speeds at Goodyear Airport during this period were from the west (260°) at 14 and 18 mph with gusts of 29 and 34 mph. On March 2, the Goodyear station measured wind speeds and gusts of equal or higher magnitude: 23 mph with 34 mph gusts from the NW (310°-320°) for two consecutive hours. Elevated wind speeds on March 2 corresponded to an increase in PM_{10} from 29 µg/m^3 to 177 µg/m^3 at the West 43rd monitoring site. This increase in PM_{10} is relatively minor compared to PM_{10} concentrations on measured on March 14, which reached at maximum of 1270 µg/m^3.

[24] NWS stations report meteorological data differently than meteorological stations operated by Maricopa County. NWS service stations report wind speeds as a 2-min average and wind gusts are defined as "a rapid fluctuation of wind speed with variations of 10 knots or more between peaks and lulls," which are reported as a 5-sec average. Maricopa County meteorological stations have the capability of reporting wind speeds as a 5-min average, an hourly average, or a maximum wind speed, which is recorded as an instantaneous reading that can be less than one second in duration.

Figure 4: Non-Exceedance Day Comparison



Similarly, on March 29, wind speeds of 16 to 17 mph with wind gusts of 29 to 32 mph from the SSW (200°) and the WSW (240°) were recorded at Goodyear Airport for a period of three hours. The corresponding PM_{10} concentrations at West 43rd remained below 130 µg/m^3 for the entire day. On the following day, March 30, wind speeds of 25 to 29 mph from the SW (230°-240°) were recorded at Goodyear, which corresponded to a spike in PM_{10} concentration at the West 43rd site. There are, however, significant differences between the spike measured on March 30 and the one measured on March 14 and flagged as an exceptional event. First, the spike on March 30 clearly follows a period of elevated wind speed while the spike measured on March 14 was coincident with or even precedes the elevated wind. In addition, the PM_{10} spike on March 30 was shorter in duration and much smaller in magnitude.

Figure 5: Non-Exceedance Day Comparison

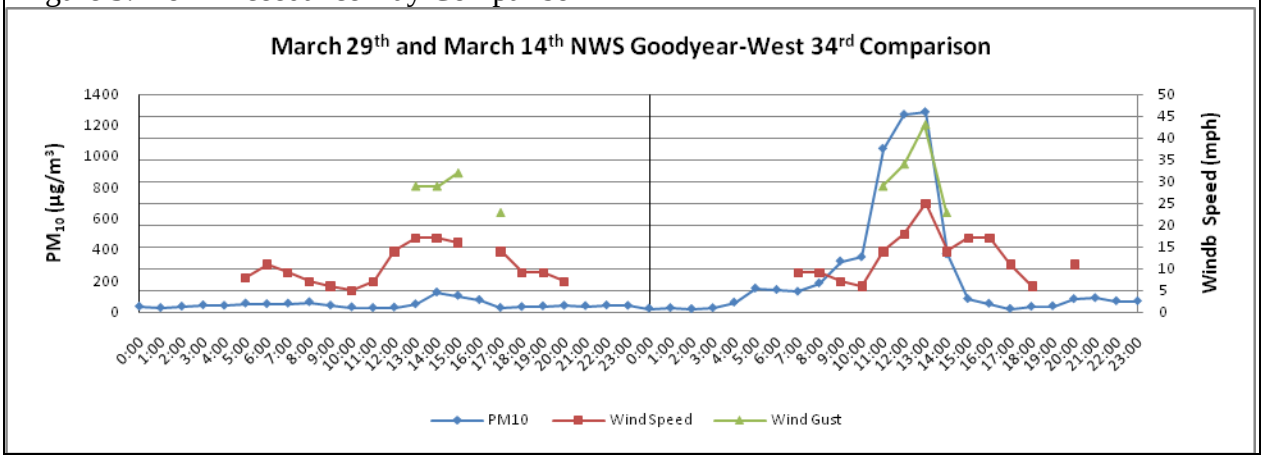
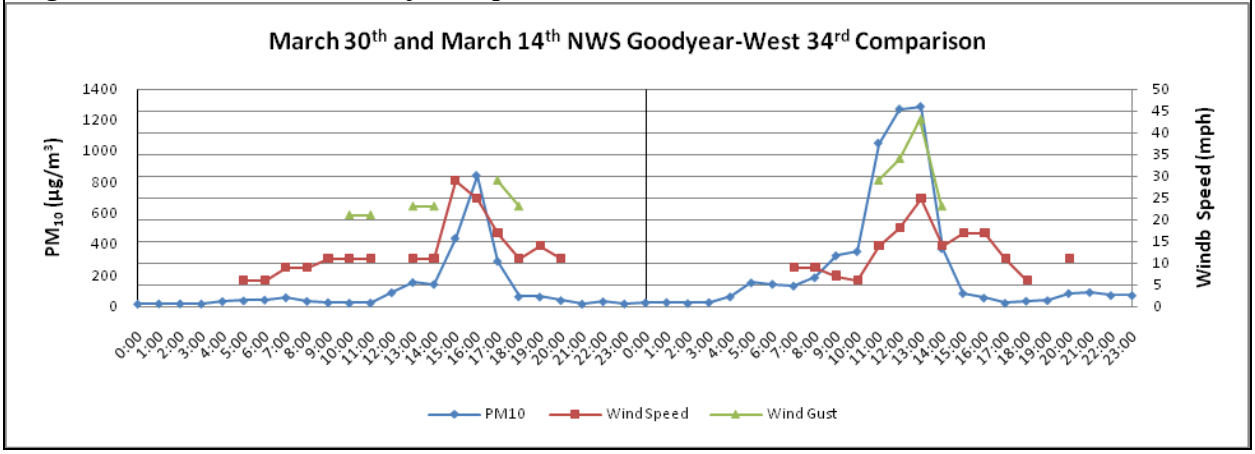


Figure 6: Non-Exceedance Day Comparison



These examples illustrate how elevated wind speeds in upwind areas are related to elevated PM_{10} concentrations on occasion, but the magnitude of PM_{10} concentrations measured at the West 43rd site seem to be associated with factors in addition to wind speed. Also, March 2, March 29, and March 30 were weekend days, which also indicates that elevated wind speeds are not necessarily the primary factor in creating elevated PM_{10} concentrations at the West 43rd site.

5.1.7 Summary of Clear Causal Relationship for March 14, 2008

ADEQ's conclusions that the recorded exceedance was caused by a regional high wind event are not substantiated by relevant monitoring and meteorological data. The data show that the spatial extent of PM_{10} during this day was isolated and not regional in nature. The data also show differences in the measured PM_{10} concentrations at the West 43rd site and the remaining sites in the Phoenix area. In addition, as explained above, ADEQ provided only limited analysis of possible contribution from human activity, making it difficult to determine the relationship between the claimed event and the exceedance. Therefore, EPA has determined that the weight of evidence presented in the March 14 Assessment does not demonstrate a clear causal relationship as required by the EER.

5.2 April 30, 2008

5.2.1 Correlation between Wind Speed and PM_{10}

The April 30 Assessment included hourly and maximum wind speed and PM_{10} data for five sites in the Phoenix area: West 43rd, Durango Complex, South Phoenix, Central Phoenix, and Higley. ADEQ also included meteorological data from the NWS Sky Harbor and Deer Valley stations.[25] ADEQ did not provide tabular hourly PM_{10} data from the other four continuous PM_{10} analyzers in the Phoenix area and did not include wind speed and direction data from numerous other meteorological stations in the Phoenix area. The assessment also did not include any information discussing the 7 filter-based monitoring sites that collected samples on this day.

[25] ADEQ also includes meteorological data from two AZMET stations. These data are collected at 3 m while NWS and Maricopa County data are collected at 10 m. There does not seem to be any correction or adjustment for the collection heights of these stations, and therefore should not be used in the exceptional events analysis.

Refer to Appendix A for more information on the PM_{10} and meteorological data used in the April 30 assessment.

ADEQ also provided four graphs that show the potential correlation between maximum wind speeds and PM_{10} concentrations. The four graphs display data from the West 43rd, Durango Complex, Greenwood, and South Phoenix monitoring sites. While the hourly PM_{10} concentrations increase with an increase in maximum recorded wind speeds at the West 43rd site, there is not a similar correlation between PM_{10} and maximum wind speed at the other monitoring sites in the area. These facts suggest that the elevated PM_{10} concentrations at West 43rd may have been caused by local upwind sources and were not regional in nature.

5.2.2 Visibility

The April 30 assessment included photographs from numerous locations throughout the Phoenix area. Unfortunately, there is not a significant discernable difference between the conditions preceding and during the event. Therefore, the photographs do not significantly contribute to establishing a clear causal relationship between wind speed, potential contributing sources, and PM_{10} concentrations at the West 43rd monitoring site.

ADEQ also stated that reduced visibility during the event at Goodyear Airport provides further evidence of a causal relationship between the high wind event and the measured exceedance at the West 43rd site. The visibility at Goodyear Airport before and during the event ranged from 20 to 7 statute miles. Other NWS stations in the area did not record any decrease in visibility throughout the entire day: visibility at Glendale Airport remained at 20 miles and Sky Harbor remained at 10 miles. At the Goodyear Airport, the minimum recorded visibility was 7 statute miles. The visibility throughout the day in the Phoenix area was never significantly reduced, and thus this information does not significantly contribute to establishing a clear causal relationship.[26]

5.2.3 Review of 24-hour PM_{10} Data

The 24-hour PM_{10} concentrations measured on April 30 at the West 43rd and surrounding sites are listed in Table 3 and shown in Figure 7. On this day, the West 43rd monitor was the only site in the entire Phoenix area to violate the 24-hour PM_{10} standard.[27] Furthermore, PM_{10} concentrations at the West 43rd site were more than double those recorded at other local sites, which is generally inconsistent with the notion that a regional high wind event caused the exceedance.

[26] See Appendix B for information regarding reduced visibility and dust storms in Arizona.

[27] Similar to the data for March 14, 2008, the only other exceedance recorded in Arizona on this day was the Cowtown monitoring site in Pinal County, which was not flagged as an exceptional event.

Figure 7: April 30, 2008 24-Hour PM_{10}

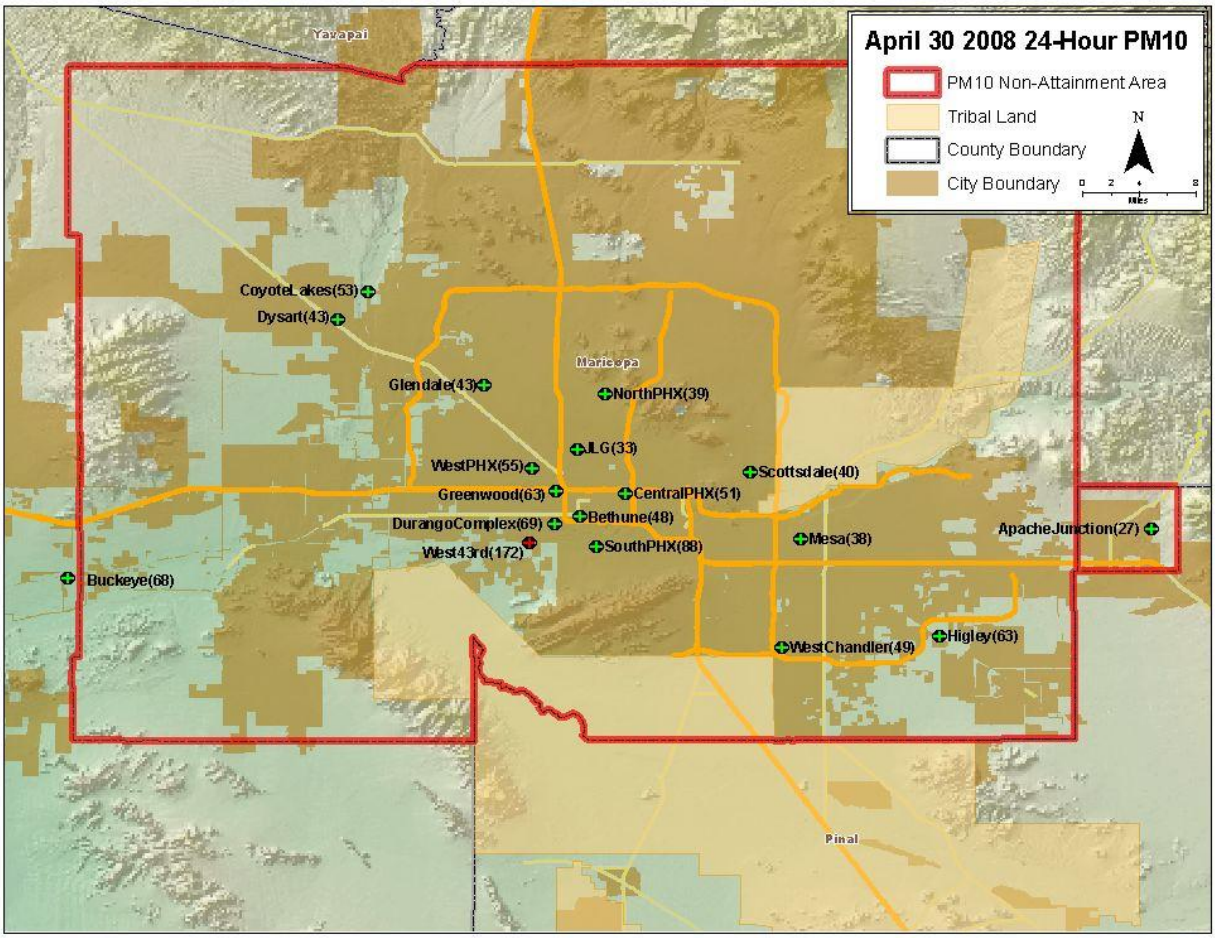


Table 3: April 30, 2008 24-Hour PM_{10}			
Site Name	**PM_{10} (ug/m^3)**	**Site Name**	**PM_{10} (ug/m^3)**
Buckeye*[28]	68	Glendale(FRM) [29]*	43
West 43rd	172	Mesa (FRM)*	38
Durango Complex	69	North PHX (FRM)*	39
South PHX	88	South Scottsdale (FRM)*	40
Greenwood	63	West Chandler (FRM)*	49
West PHX	55	Bethune Elementary (FRM)*	48
Central PHX	51	Dysart (FRM)*	43
JLG Supersite	46	Coyote Lakes	53
Higley	63		

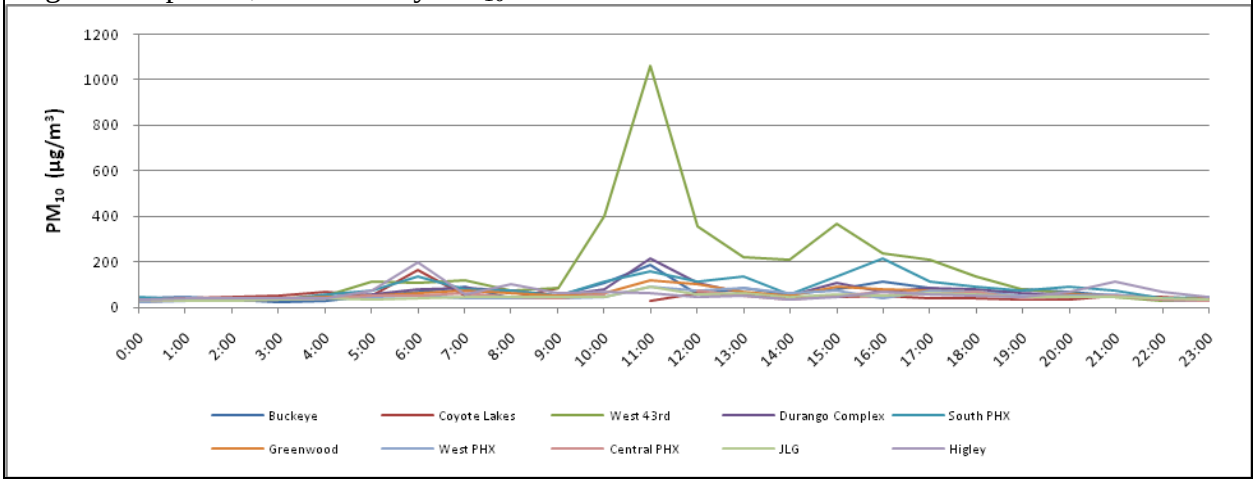
[28] 24-hour PM_{10} data for these sites were not included in the Assessment.
[29] PM_{10} FRM samplers operate on a 1 in 6 day schedule.

5.2.4 Review of Hourly PM_{10} and Meteorological Data

The hourly PM_{10} data are shown in Figure 8. As early as 1000 hrs, the West 43rd site began to experience an increase in PM_{10} concentration that was not characteristic of the other nine monitors in the Phoenix area. From 0900 to 1000 hrs the hourly PM_{10} values at the West 43rd site increased from 85 µg/m^3 to 404 µg/m^3, while PM_{10} values at surrounding sites remained below 120 µg/m^3. The first sign of any elevated winds occurred at the majority of the stations around 1100 hrs. NWS data for Goodyear Airport showed an increase in wind speed from 16 to 17 mph (accompanied by a 29 mph gust); while an increase in hourly wind speed from 12.7 to the day's maximum value of 16 mph was recorded at the West 43rd site. At 1100 hrs, the PM_{10} concentration at the West 43rd site also rose from 404 µg/m^3 to the day's maximum value of 1065 µg/m^3.

While values at other sites in the area increased over the same time period, the values at the West 43rd site ranged from 5 to 10 times higher than other sites in the Phoenix area. For example, the majority of the sites measured maximum PM_{10} concentrations that were coincident with the maximum PM_{10} concentrations at the West 43rd site, but all sites in Maricopa County measured maximum PM_{10} concentrations less than 220 µg/m^3. Given that the Durango Complex, South Phoenix, Greenwood, and West Phoenix sites are located within approximately five miles of the West 43rd site, one would expect to see greater consistency in the concentrations if a regional high wind event was occurring. The data suggest that the West 43rd site was most likely significantly influenced by local upwind sources and the claimed exceptional event was not regional in nature.

Figure 8: April 30, 2008 Hourly PM_{10}

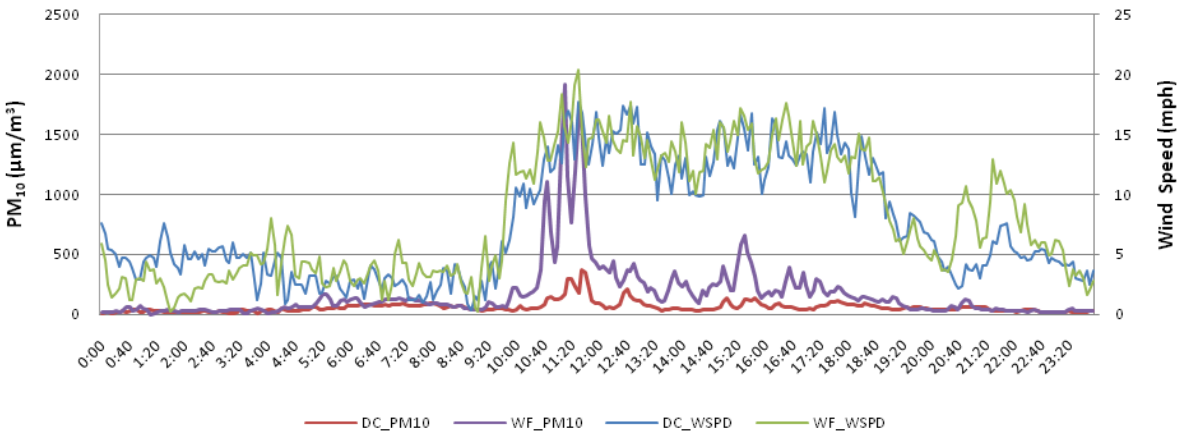


5.2.5 Review of 5-Min PM_{10} and Wind Speed Data

The 5-min data reinforce the fact that even though elevated wind speeds were measured at other nearby locations, the West 43rd monitor consistently measured much higher PM_{10} concentrations than other locations. Figure 9 shows the 5- min PM_{10} and wind speed data from West 43rd and Durango Complex. These monitors are located only 2 miles apart, yet there seems to be a considerable difference in the relationship between PM_{10} and wind speed on April 30. Both sites experience similar wind speed levels, but during some periods of the day the 5-min PM_{10}

concentrations at West 43rd site were more than 9 times those measured at Durango Complex. The two highest 5-min PM_{10} averages measured at the West 43rd site were approximately 1920 and 1624 µg/m^3, while PM_{10} concentrations at Durango Complex during the same time period were 178 and 373 µg/m^3, respectively. These data provide further evidence that the claimed regional high wind event only affected PM_{10} concentrations at the West 43rd site and the elevated PM_{10} concentrations measured at this site were most likely significantly influenced by local sources and the claimed exceptional event was not regional in nature.

Figure 9: April 30, 2008 5-Min PM_{10} and Wind Speed

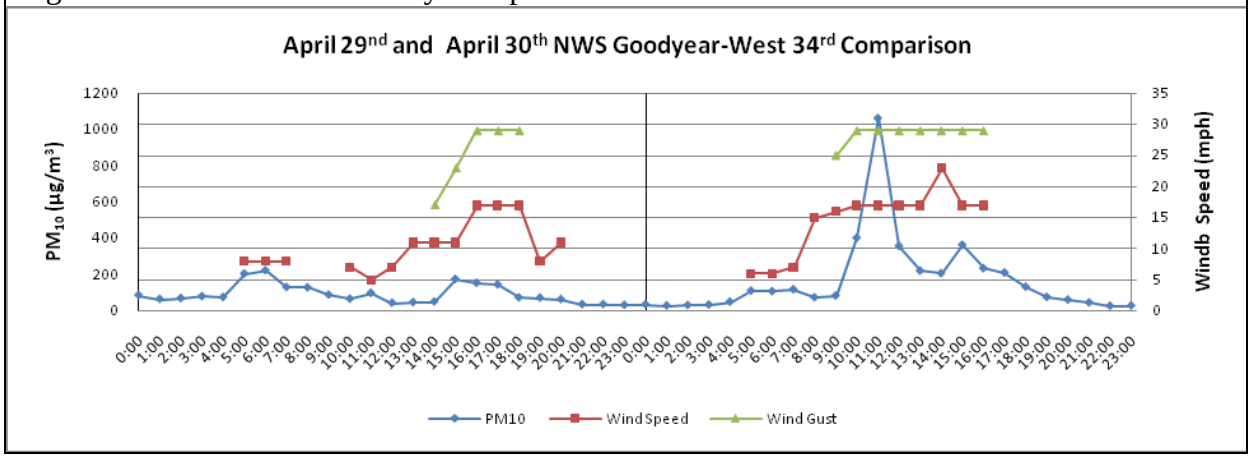


5.2.6 Review of Days with Similar Meteorological Conditions

On twenty days in April 2008, the wind speeds at Goodyear Airport exceeded 15 mph. On six of those days, wind gusts exceeded 25 mph. The following analysis compares the hourly PM_{10} data, wind speed, and wind gusts recorded at Goodyear Airport on April 30 with the same data from a similar day in April.

On April 30, the West 43rd monitor experienced elevated PM_{10} concentrations of 404 µg/m^3 and 1065 µg/m^3 at 1000 and 1100 hrs, respectively. Wind speeds at Goodyear Airport during this period were from the WSW (240°-260°) at 17 mph with gusts of 29 mph. On April 29, the Goodyear station measured wind speeds and gusts of equal magnitude; 17 mph winds and 29 mph gusts from the SW (230°) for three consecutive hours. A maximum concentration of 177 µg/m^3 was observed during this period, but it is considerably lower than the PM_{10} concentrations measured on the day the exceptional event is claimed to have occurred. This example illustrates how elevated wind speeds in upwind areas are related to elevated PM_{10} concentrations on occasion, but the magnitude of PM_{10} concentrations measured at the West 43rd site seem to be dependent on a number of different factors.

Figure 10: Non-Exceedance Day Comparison



5.2.7 Summary of Clear Causal Relationship for April 30, 2008

ADEQ's conclusions that the recorded exceedance was caused by a regional high wind event are not substantiated by relevant monitoring and meteorological data. The data show that the spatial extent of PM_{10} during this day was isolated and not regional in nature. The data also show differences in the measured PM_{10} concentrations at the West 43rd site and the remaining sites in the Phoenix area. In addition, ADEQ provided only limited analysis of possible contribution from human activity, making it difficult to comprehensively evaluate the relationship between the claimed event and the exceedance. Therefore, EPA has determined that the weight of evidence presented in the April 30 Assessment does not demonstrate a clear causal relationship as required by the EER.

5.3 May 21, 2008

5.3.1 Correlation between Wind Speed and PM_{10}

The May 21 Assessment included tabular hourly and maximum wind speed and PM_{10} data for five sites in the Phoenix area: West 43rd, Durango Complex, South Phoenix, and Buckeye.[30] ADEQ also included meteorological data from the NWS Luke Air Force Base station. ADEQ did not provide hourly PM_{10} and meteorological data from the remaining five continuous PM_{10} analyzers in the Phoenix area and did not include wind speed and direction data from numerous other meteorological stations in the Phoenix area. Appendix A contains more information on the PM_{10} and meteorological data used in the May 21assessment.

ADEQ also provided three graphs that show the potential correlation between maximum wind speeds and PM_{10} concentrations. The three graphs display data from the West 43rd, Durango Complex, and South Phoenix monitoring sites. While the hourly PM_{10} concentrations significantly increase with an increase in maximum recorded wind speeds at the West 43rd site,

[30] ADEQ's supporting documentation for this event also contained information pertaining to measured exceedances at monitoring sites in Yuma County (Yuma Courthouse site). The Yuma monitor is more than 150 miles from the West 43rd site. We expect the circumstances that caused the exceedance at the Yuma MCAS site to be different that those affecting the Phoenix area; therefore we are giving this data relatively little weight in our evaluation.

there is not a similar correlation between PM_{10} and maximum wind speed at the other monitoring sites in the area. These facts suggest that the elevated PM_{10} concentrations at West 43rd may have been caused by local upwind sources and were not regional in nature.

5.3.2 Visibility

The assessment included photographs from numerous locations throughout the Phoenix area. Photographs taken at 1330 hrs show evidence of reduced visibility and a potential regional event; however, PM_{10} concentrations at the West 43rd site began to increase at 0800 hrs. Photographs were provided for 0930, 1330, 1430, and 1530 hrs. Photographs were not submitted for the hours preceding the elevated PM_{10} concentrations measured at the West 43rd site. Therefore, the photographs do not significantly contribute to establishing a causal relationship between wind speed, potential contributing sources, and PM_{10} concentrations at the West 43rd monitoring site during the morning hours.

ADEQ also stated that reduced visibility during the event throughout portions of Phoenix provides further evidence of a clear causal relationship. The visibility at Goodyear Airport before the event ranged from 20 to 7 statute miles; visibilities of 7 miles were recorded at 1047, 1647, and 1747 hrs. Chandler Airport recorded observations of blowing dust (BLDU) at 1347 hrs, which was followed by a recorded visibility of 7 miles at 1447 hrs. Visibility at other NWS stations in the area remained above 10 miles for the entire day: Glendale Airport ranged from 10 to 20 miles, Sky Harbor remained at 10 miles, and Luke Air Force Base remained at 10 miles. The visibility throughout the day in the Phoenix area was never significantly reduced, and thus this information does not significantly contribute to establishing a clear causal relationship.[31]

5.3.3 Review of 24-Hour PM_{10} Data

The 24-hour PM_{10} concentrations measured on May 21 at the West 43rd and surrounding sites are listed in Table 4 and shown geographically in Figure 11. On this day, the West 43rd monitor was the only site in the entire Phoenix area to violate the 24-hour PM_{10} standard. Furthermore, PM_{10} concentrations at West 43rd were more than double those recorded at other local sites, which is generally inconsistent with the notion that a regional high wind event caused the exceedance.

[31] See Appendix B for information regarding reduced visibility and dust storms in Arizona.

Figure 11: May 21, 2008 24-Hour PM_{10}

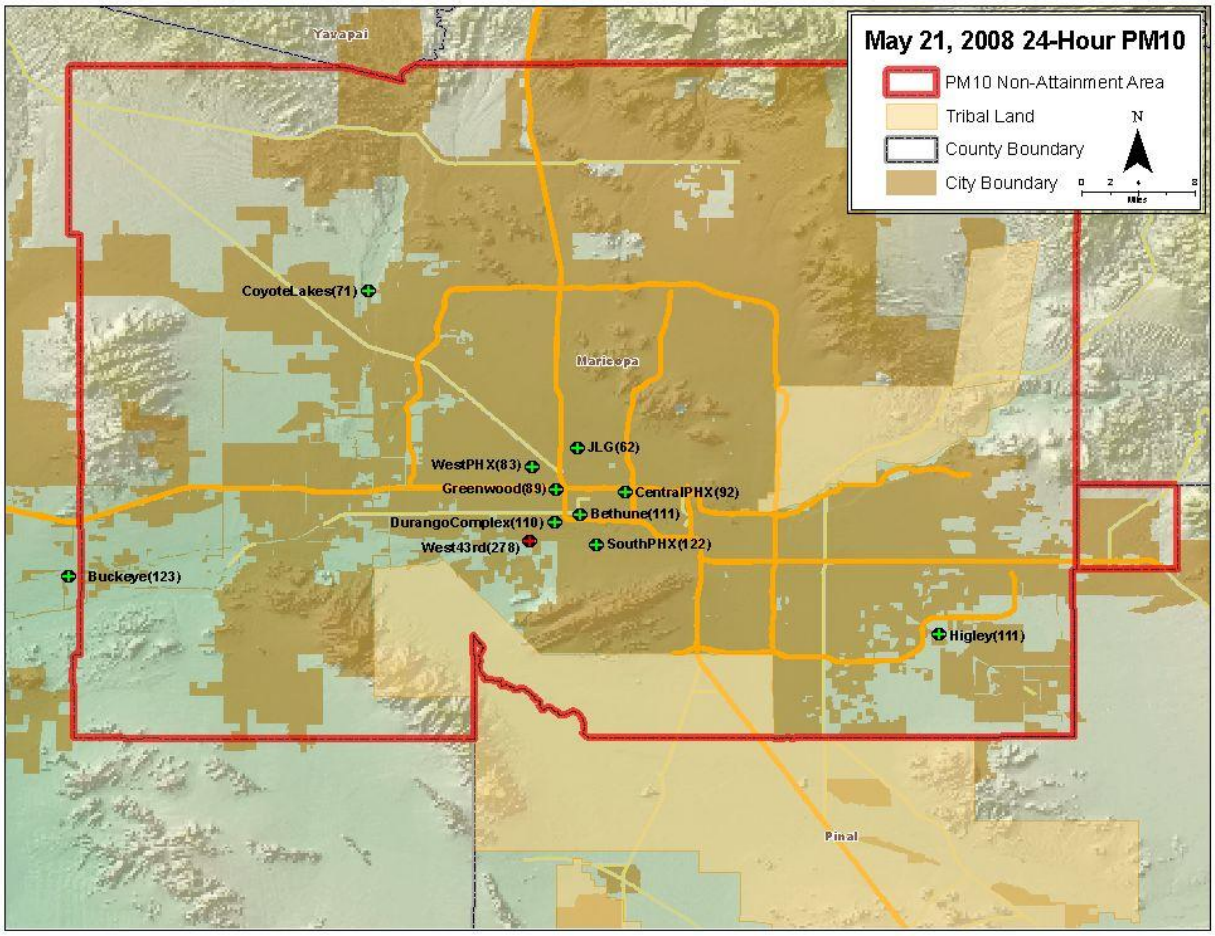


Table 4: May 21, 2008 24-Hour PM_{10}			
Site Name	**PM_{10} (ug/m3)**	**Site Name**	**PM_{10} (ug/m3)**
Buckeye*[32]	123	West PHX*	83
West 43rd	278	Central PHX*	92
Durango Complex	110	JLG Supersite*	62
South PHX	122	Higley*	111
Greenwood	89	Coyote Lakes*	71
Bethune (FRM)*	111		

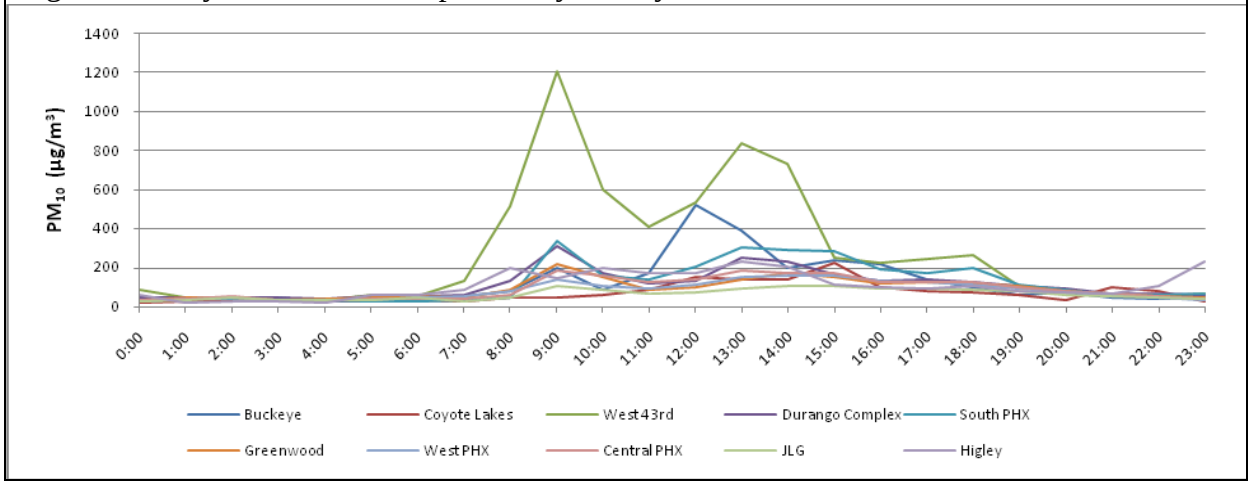
5.3.4 Review of Hourly PM_{10} and Meteorological Data

The hourly PM_{10} data for Maricopa County are shown in Figure 12. The peak PM_{10} concentration of 1207 µg/m^3 at 0900 hrs measured at the West 43rd site coincides with an increase in wind speed from 11 to 22 mph, and a recorded wind gust of 28 mph at the Goodyear

[32] 24-hour PM_{10} data from these sites were not included in the Assessment.

station and an increase in hourly wind speed from 15.3 to 18.1 mph at the West 43rd monitoring site. Similar to previously discussed events, the measured PM_{10} concentrations at West 43rd were more than 3.9 times the PM_{10} values measured at the Durango Complex station just 2 miles to the northeast and 3.6 times the values measured at the South Phoenix station 4 miles to the east. The inconsistencies in PM_{10} concentrations suggest that the West 43rd site most likely was influenced by local upwind sources and the claimed exceptional event was not regional in nature.

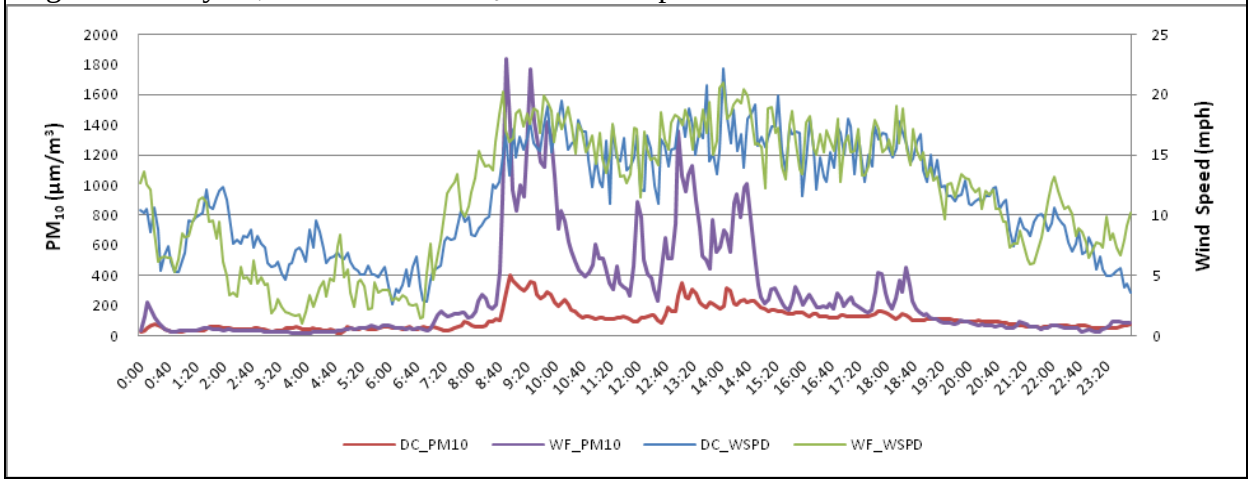
Figure 12: May 21, 2008 Maricopa County Hourly PM_{10}



5.2.5 Review of 5-Min PM_{10} and Wind Speed Data

The 5-min data reinforce the fact that even though elevated wind speeds were measured at other nearby locations, the West 43rd monitor consistently measured much higher PM_{10} concentrations than other locations. Figure 13 shows the 5- min PM_{10} and wind speed data from the West 43rd and Durango Complex sites. These monitors are located only 2 miles apart, yet there seems to be a considerable difference in the relationship between PM_{10} and wind speed on May 21. Both sites experience similar wind speed levels, but during some periods of the day the 5-min PM_{10} concentrations at West 43rd site ranged from 3-6 times higher than those measured at Durango Complex. The two highest 5-min PM_{10} averages measured at the West 43rd site were approximately 1837 and 1769 µg/m^3, while PM_{10} concentrations at Durango Complex during the same time period were 290 and 362 µg/m^3, respectively. These data provide further evidence that the claimed regional high wind event only affected PM_{10} concentrations at West 43rd and the elevated PM_{10} concentrations measured at this site were most likely significantly influenced by local sources and the claimed exceptional event was not regional in nature.

Figure 13: May 21, 2008 5-Min PM_{10} and Wind Speed

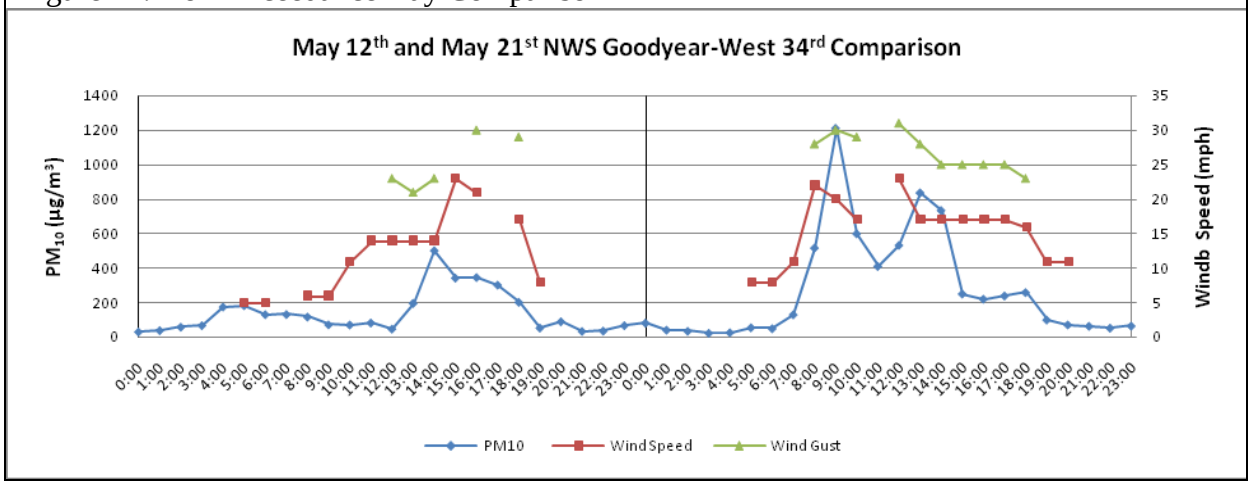


5.3.6 EPA Review of Days with Similar Meteorological Conditions

On fourteen days in May 2008, the wind speed at Goodyear Airport exceeded 15 mph. On three of those days, wind gusts exceeded 25 mph. The following analysis compares the hourly PM_{10} data, wind speed, and wind gusts on May 21 with the same data from a similar day in May.

On May 21, the West 43rd monitor experienced elevated PM_{10} concentrations of 518 µg/m^3 and 1207 µg/m^3 at 0800 and 0900 hrs, respectively. Wind speeds at Goodyear Airport during this period were from the WSW (240°) at 22 and 21 mph with gusts of 28 and 30 mph. Similarly, on May 12, the Goodyear station measured wind speeds and gusts of equal magnitude; 21 mph wind speeds and 30 mph gusts from the SW (230°). These elevated wind speeds, however, only correspond to moderate hourly PM_{10} values at the West 43rd site. Hourly PM_{10} concentrations on May 12 were considerably lower than the PM_{10} concentrations measured on the day the exceptional event is claimed to have occurred; maximum PM_{10} values on May 12 only reached 500 µg/m^3. This example illustrates how elevated wind speeds in upwind areas are related to elevated PM_{10} concentrations on occasion, but the magnitude of PM_{10} concentrations measured at the West 43rd site seem to be dependent on a number of different factors.

Figure 14: Non-Exceedance Day Comparison



5.3.7 Summary of Clear Causal Relationship for May 21, 2008

ADEQ's conclusions that the recorded exceedance was caused by a regional high wind event are not substantiated by relevant monitoring and meteorological data. The data show that the spatial extent of PM_{10} during this day was isolated and not regional in nature. The data also show differences in the measured PM_{10} concentrations at the West 43rd site and the remaining sites in the Phoenix area. In addition, as explained above, ADEQ provided only limited analysis of possible contribution from human activity (sections 4.2 and 4.3 above), making it difficult to comprehensively evaluate the relationship between the claimed event and the exceedance. Therefore, EPA has determined that the weight of evidence presented in the May 21 Assessment does not demonstrate a clear causal relationship as required by the EER.

5.4 June 4, 2008 Event

The June 4 assessment contained information pertaining to measured exceedances at monitoring sites in both the Phoenix area (Buckeye, Coyote Lakes, and West 43rd site) and Yuma County (Yuma MCAS site). These two locations are over 150 miles apart and the data concerning the Yuma area has limited value in determining whether or not exceptional events occurred in the Phoenix area. It is also important to note that EPA is not evaluating the exceedances measured at the Buckeye and Coyote Lakes monitoring sites in this document. As discussed in the next section, it is clear that the PM_{10} concentrations at these sites are not correlated to those measured at the West 43rd site for the majority of the day on June 4 and were most likely influenced by a different set of sources and meteorological conditions (Figure 16).

5.4.1 Correlation between Wind Speed and PM_{10}

The assessment included tabular wind speed and PM_{10} data for five sites in the Phoenix area: West 43rd, Durango Complex, Central Phoenix, Coyote Lakes, and Buckeye. ADEQ also included meteorological data from the NWS Luke Air Force Base station. ADEQ did not provide tabular hourly PM_{10} data from the remaining five continuous PM_{10} analyzers in the Phoenix area and did not include wind speed and direction data from numerous other meteorological stations in the Phoenix area. Appendix A contains more information on the meteorological data used in the June 4 supporting documentation.

ADEQ also provided seven graphs that show the potential correlation between maximum wind speeds and PM_{10} concentrations. The graphs show that, at the West 43rd site, the hourly PM_{10} concentrations increase with an increase in maximum recorded wind speeds at the West 43rd site; however, there does not seem to be a similar correlation between PM_{10} and maximum wind speed for the other monitoring sites in the area until later in the evening. These data suggest that the elevated PM_{10} concentrations in the morning and early afternoon hours at the West 43rd site were most likely caused by local upwind sources and are not regional in nature.

5.4.2 High Winds

While Section 4.3 contains a general discussion of ADEQ's high wind analysis, ADEQ's DSR provided a more detailed discussion of the meteorological conditions that were associated with

the claimed exceptional event occurring on June 4. Unlike the previously discussed events, the DSR contained copies of NWS advisories concerning the meteorological conditions in the Phoenix area. These reports provide additional evidence of the nature of the wind speeds associated with the claimed exceptional event. Specifically, NWS issued a wind advisory at 0356 hrs on June 4 that was set to be in effect from 1500 to 2100 hrs. The advisory states that "wind speeds of 25 to 30 mph with gusts up to 40 mph can be expected" and warned that "strong winds over desert areas could result in briefly lowered visibilities to well under a mile at times in blowing dust or blowing sand…especially near empty farm fields and construction areas."

While these advisories continued to be in effect during the afternoon hours of June 4, the average hourly wind speeds observed at the West 43rd monitoring site never exceeded 17.1 mph for the entire day, while wind gusts reached a maximum of 36 mph at 1600 hrs. ADEQ's DSR states that during the afternoon hours the Phoenix area experienced "unusually high gusts of 35-40 mph which would likely overwhelm BACM in place for PM in the Phoenix" area, but as discussed in section 4.2.2, ADEQ has not determined at which wind speeds this may be occurring. As discussed below, the West 43rd monitoring site began measuring elevated PM_{10} concentrations at 1200 hrs, well before the NWS advisories were put into effect.

5.4.3 Visibility

The assessment included photographs from numerous locations throughout the Phoenix area. Photographs taken at 1830 hrs show evidence of reduced visibility and a potential regional event,[33] but it is important to note that PM_{10} concentrations at the West 43rd monitoring site began to increase at 1200 hrs. No photographs were submitted for this time period or for hours preceding the elevated PM_{10} concentrations. Therefore, the photographs do not significantly contribute to establishing a causal relationship between observed wind speeds, potential contributing sources, and PM_{10} concentrations at the West 43rd monitoring site during the late morning, early afternoon hours.

ADEQ also stated that reduced visibility during the event at Goodyear Airport provides further evidence of a clear causal relationship. The visibility at Goodyear Airport during the morning and early afternoon hours ranged from 20 to 10 statute miles. While the reduced visibility observed at numerous NWS after 1800 hrs suggests a regional event may have occurred, it is important to note that PM_{10} concentrations at the West 43rd site began to increase at 1200 hrs: a time when visibility was between 10 to 20 miles.

5.4.4 Review of 24-Hour PM_{10} Data

The 24-hour PM_{10} concentrations measured on June 4 at the West 43rd and surrounding sites are shown in Figure 15. On this day, the West 43rd monitor measured PM_{10} concentrations that were more than double those measured at other monitoring sites in the area, except for the Buckeye and Coyote Lakes sites, which recorded similar concentrations.

[33] See Appendix B regarding visibility and dust storms in Arizona.

Figure 15: June 4, 2008 24-Hour PM_{10}

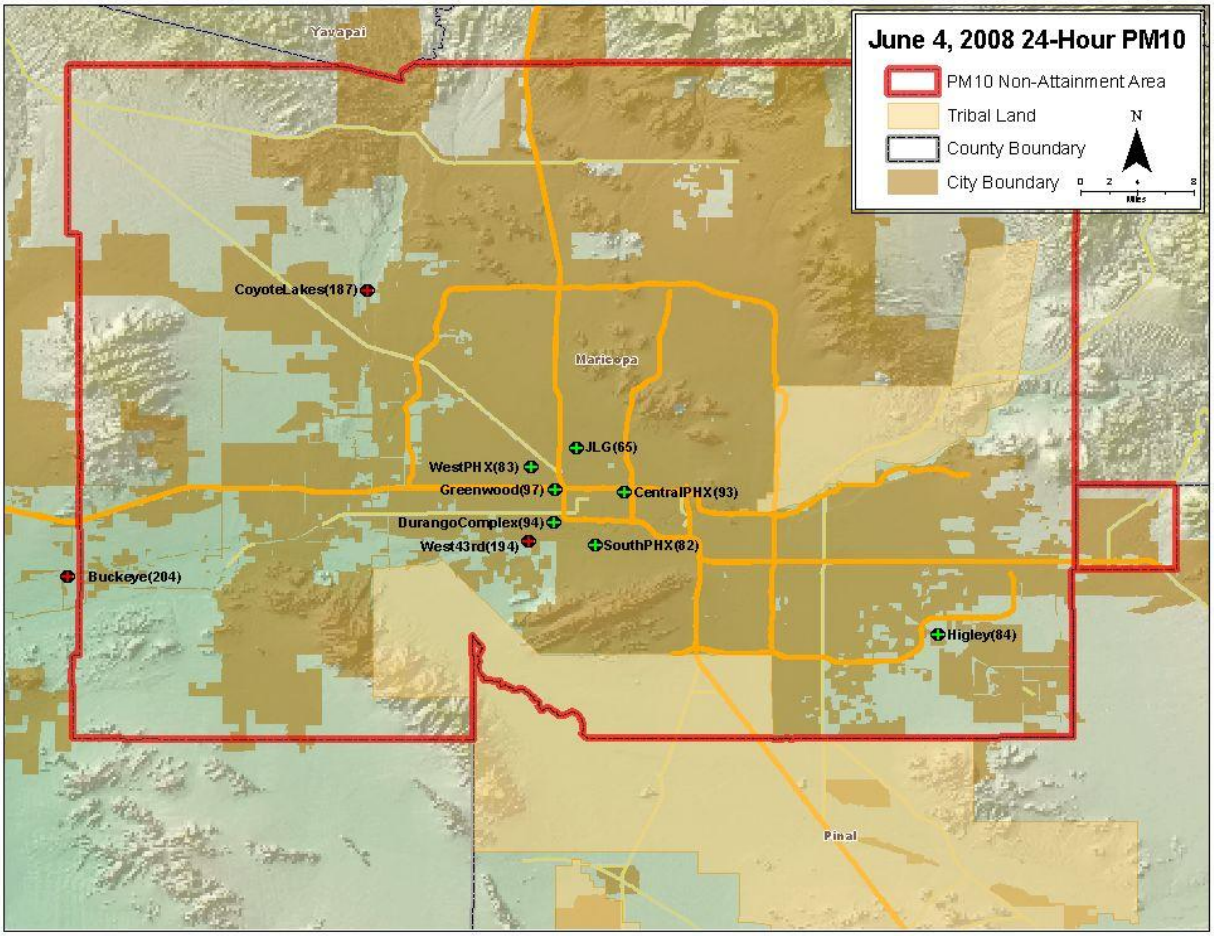


Table 5: June 4, 2008 24-Hour PM_{10}			
Site Name	**PM_{10} (ug/m3)**	**Site Name**	**PM_{10} (ug/m3)**
Buckeye	204	Greenwood*	97
West 43rd	194	West PHX*	83
Coyote Lakes	187	Central PHX*	93
Durango Complex*[34]	94	JLG Supersite*	65
South PHX*	82	*Higley*	84

5.4.5 Review of Hourly PM_{10} and Meteorological Data

The patterns observed through the morning hours and mid-day on June 4 are similar to the claimed exceptional event days discussed in previous sections and the data from this time period does not indicate an influence from a regional high wind event. Also, similar to the previously

[34] 24-hour PM_{10} data for this station was not included in the Assessment.

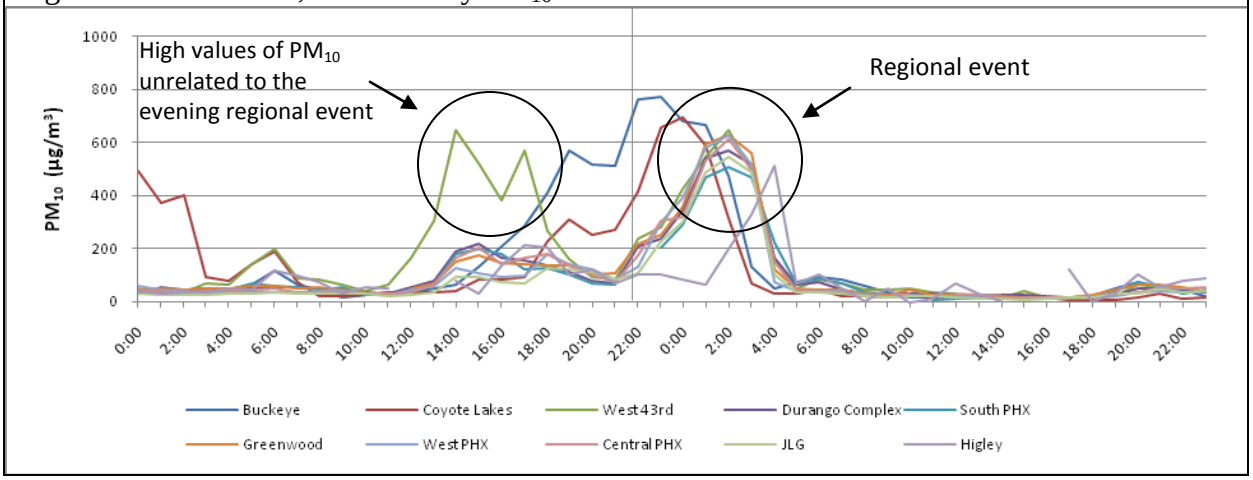
discussed events, the West 43rd site measured elevated PM_{10} concentrations earlier and of a higher magnitude than other monitoring sites located nearby. For example, on the early afternoon of June 4, the West 43rd monitor began measuring PM_{10} concentrations ranging from 165 $\mu g/m^3$ to 645 $\mu g/m^3$ between 1200 and 1400 hrs, while all other monitors in the Phoenix area remained below 200 $\mu g/m^3$ for the same time period. The inconsistencies in these concentrations suggest that the West 43rd site was most likely significantly influenced by local upwind sources and the claimed exceptional event was not regional in nature. ADEQ acknowledged that the concurrent timing of elevated wind speeds "may indicate that PM sources in close proximity to the monitor contributed significantly to the dust event" and "it is likely that the loose particulates deposited in the dry river bed to the west and south-west of the monitor were transported the short distance to the West 43rd monitor by the high winds."[35]

It appears that a regional weather event began on the evening of June 4 and lasted into the morning of June 5. Figure 16 shows that the Buckeye site begins to measure significantly elevated PM_{10} concentrations at 1600 hrs, followed by an increase in PM_{10} at the Coyote Lakes site a few hours later. The West 43rd site lagged behind Buckeye and Coyote Lakes and did not show elevated PM_{10} from the regional event until 2200 hrs on June 4. While the West 43rd, Buckeye, and Coyote Lakes sites all exceeded on June 4, the cause of the exceedances seems to be different. The exceedances at Buckeye and Coyote Lakes were most likely due to a regional event that began in the evening and did not reach West 43rd until 2200 hrs, while the exceedance at West 43rd was most likely caused by a different set of circumstances (Figure 16). Also, beginning around 2200 hrs and extending into the early morning hours of June 5, PM_{10} concentrations at all sites in the Phoenix area were elevated and uniformly consistent, illustrating a potential regional event. In the DSR, ADEQ acknowledged that "a more homogeneous dust plume affected the area just after midnight on the following day."

While there was some contribution to the 24-hour PM_{10} concentration that can be attributed to this evening event, the West 43rd monitor began measuring high PM_{10} concentrations well before the arrival of the "dust plume" described in the June 4 DSR. Furthermore, the arrival of the dust plume began at around 2100 hrs and only contributed to approximately 11.3 percent of the total PM_{10} mass concentration for June 4. With such a small total contribution, if all PM_{10} concentrations measured after 2100 hrs were completely removed from the data set, the PM_{10} 24-hour average for June 4 would still be above the PM_{10} 24-hour NAAQS. The majority of the PM_{10} mass was measured well before the arrival of the evening event described above and the high PM_{10} concentrations measured in the late morning and early afternoon hours have been determined to be independent from the regional event that took place on the evening of June 4.

[35] June 4 DSR at p. 24.

Figure 16: June 4 & 5, 2008 Hourly PM_{10}

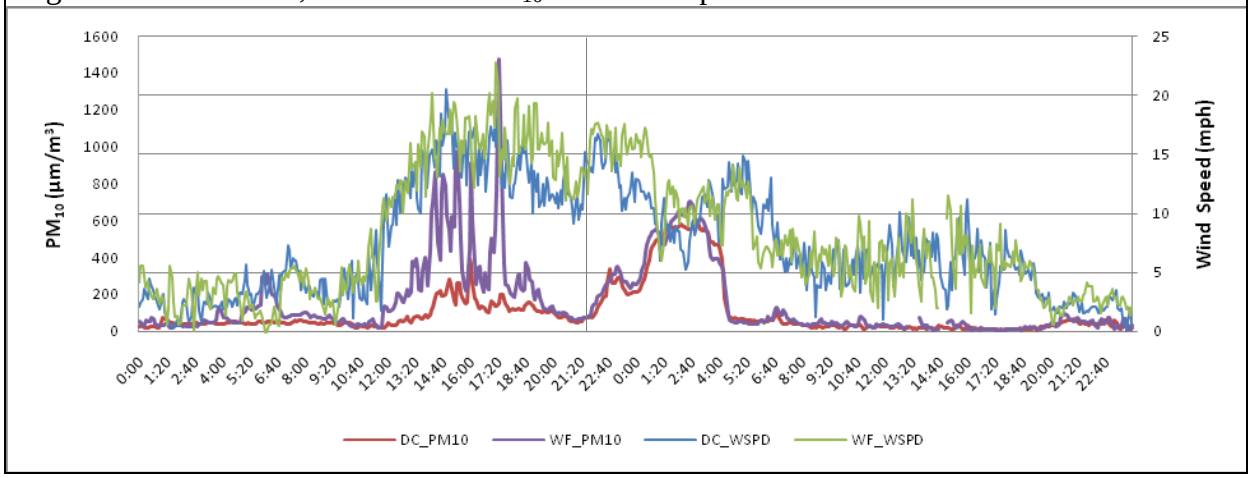


5.4.6 Review of 5-Min PM_{10} and Wind Speed Data

The 5-min data also show that even though elevated wind speeds were measured at other nearby locations, the West 43rd monitor consistently measured much higher PM_{10} concentrations than other locations. Figure 18 shows the 5- min PM_{10} and wind speed data from West 43rd and Durango Complex:. these monitors are located only 2 miles apart, yet there seems to be a considerable difference in the relationship between PM_{10} and wind speed on June 4 during the late morning and early afternoon hours. Both sites experience similar wind speed levels, but during some periods of the day the 5-min PM_{10} concentrations at West 43rd site ranged from four to nine times higher than those measured at Durango Complex. The two highest 5-min PM_{10} averages measured at the West 43rd site were approximately 1475 and 975 µg/m^3, while PM_{10} concentrations at Durango Complex during the same time period were 153 and 264 µg/m^3, respectively.

These data provide further evidence that the claimed regional high wind event only affected PM_{10} concentrations at West 43rd and the elevated PM_{10} concentrations measured at this site in the morning and early afternoon hours were most likely significantly influenced by local sources and the claimed exceptional event was not regional in nature.

Figure 17: June 4 & 5, 2008 5-Min PM_{10} and Wind Speed

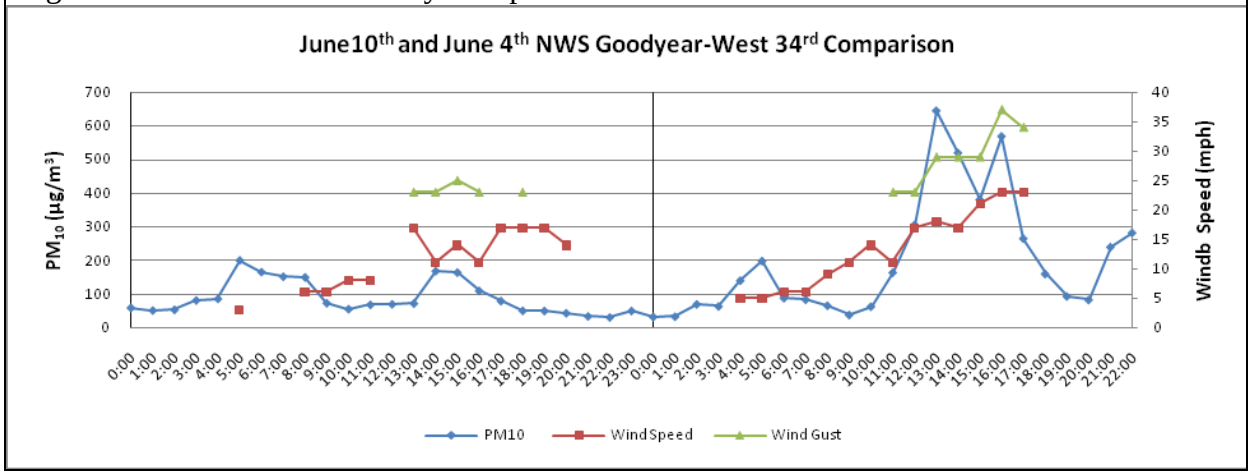


5.4.7 Review of Days with Similar Meteorological Conditions

On twelve days in June 2008, the wind speed at Goodyear Airport exceeded 15 mph. On two of those days, wind gusts exceeded 25 mph. The following analysis compares the hourly PM_{10} data, wind speed, and wind gusts on June 4 with the same data from a similar day in May.

On June 4, the West 43rd monitor experienced elevated PM_{10} concentrations of 307 µg/m^3 and 644.9 µg/m^3 at 1300 and 1400 hrs, respectively. Wind speeds at Goodyear Airport during this period were from the WSW (242°) at 17 and 18 mph with gusts of 23 and 29 mph. Similarly, on June 10, the Goodyear station measured wind speeds and gusts of similar magnitude; 17 mph wind speeds and 23 mph gusts from the WSW (240°). These elevated wind speeds, however, only correspond to a slight increase in hourly PM_{10} values at the West 43rd site. This example illustrates how elevated wind speeds in upwind areas are related to elevated PM_{10} concentrations on occasion, but the magnitude of PM_{10} concentrations measured at the West 43rd site seem to be dependent on a number of different factors.

Figure 18: Non-Exceedance Day Comparison



5.4.8 Summary of Clear Causal Relationship for June 4, 2008

The data show that the spatial extent of PM_{10} during the early portion of the day was isolated and not regional in nature. In addition, ADEQ did not adequately address the possible contributing sources in the area directly upwind of the West 43rd monitor, which makes a causal relationship difficult to evaluate. ADEQ has also failed to adequately explain the differences in the measured PM_{10} concentrations at the West 43rd site and the remaining sites in the Phoenix area experiencing similar wind conditions.

ADEQ asserted that while elevated wind speeds occurred throughout the Phoenix area, "the blowing dust that was generated from these high winds occurred at sporadic locations;" the "high concentrations of blowing dust only occurred where dust sources were located;" and "these dust sources are typically located in depositional areas where fine and coarse particles are deposited during times of precipitation." ADEQ further concluded that "cause of the exceedances for the Maricopa County monitors was alluvial dust generated by high winds in the river channels, coupled with the generally elevated dust from the region-wide dust storm." Even more explicitly, ADEQ explained that the exceedance at West 43rd "was due to generally elevated PM_{10} from the dust storm coupled with contributions from dust generated in the alluvial plain of the Salt and Gila Rivers due to high, gusty winds." While ADEQ has concluded that the exceedance at West 43rd was caused by emissions originating in the Salt and Gila River channels, there little technical justification supporting this conclusion and there is no discussion explaining how emissions from these sources are not reasonably controllable or preventable.

While there appears to be some component of the PM_{10} that could be attributed to a regional dust storm event, the time series (Figures 16 and 17) indicate that the regional event did not influence the measured PM_{10} at the West 43rd site until very late on June 4 and the principal cause of the exceedance were emissions from local sources. Therefore, the weight of evidence does not demonstrate a clear causal relationship as required by the EER.

6.0 Concentration in Excess of Normal Historical Fluctuations

Pursuant to 40 CFR 50.14(c)(3)(iii)(C), the demonstration must show that "the event is associated with a measured concentration in excess of normal historical fluctuations." ADEQ provided tables for each event that ranked the PM_{10} exceedances using data from the past five years (2003-2008). A comparison was made to five years of data from the "spring season" and the complete five year data set. Table 6 summarizes these data.

Table 6: ADEQ Historical Distribution

Exceedance Date	PM_{10} Concentration	Seasonal Percentile	Yearly Percentile
3.14.08	251 µg/m^3	< 99.5	< 99.5
4.30.08	172 µg/m^3	< 97.5	< 99.7
5.21.08	279 µg/m^3	< 99.5	< 99.5
6.4.08	194 µg/m^3	< 97.5	< 99.0

There is no specific threshold test for this requirement, but concentrations in the high percentiles can provide supporting evidence and informs EPA's weight of evidence analysis of the exceptional events in question. As stated in the EER preamble, "For extremely high concentrations relative to historical values, a lesser amount of documentation or evidence may be required." [36] While the relative comparison to the historical fluctuations informs the amount of evidence required, for an event to be considered an exceptional event, all criteria listed under section 3.0 must be met.

7.0 No Exceedances But For the Event

Pursuant to 40 CFR §50.14(c)(3)(iii)(D), the demonstration must show that "there would have been no exceedance or violation but for the event." The weight of evidence in a demonstration does not require a precise estimate of the air quality impact from the event,[37] though such information could be useful.

Assessments for all events include an "event contribution analysis" to support the notion that there would have been no exceedance but for the event. This analysis consists of a table that calculates the 24-hour PM_{10} concentration excluding the hours of the day that the event was assumed to have occurred. There is no explanation of how to interpret this analysis, and it is unclear how these hours are chosen for exclusion. Also, from the documentation alone, it is unclear how this calculation is performed. After conversations with staff members of ADEQ, it was determined that the hours that have been chosen for exclusion are replaced by the average PM_{10} concentration calculated with remaining hours of the day. This is equivalent to assuming there is no normal increase during those hours. If there is a typical rise during that period, then the average used may not be representative of typical conditions. Considering the weight of evidence, the assessments for all four events do not provide sufficient evidence to establish that there would not have been an exceedance but for the event.

8.0 Procedural Requirements

The EER at 40 CFR §50.14(c)(2)(iii) requires that data claimed to be due to an exceptional event must be flagged in the AQS database, and that an initial description of the event be provided to EPA by July 1 of the year following the event.

Pursuant to 40 CFR §50.14(c)(3)(i) the State must submit a demonstration to EPA within three years of the event. EPA received the final demonstrations for the 2008 events in question on November 17, 2009, which satisfies the three year submission requirement.

40 CFR §50.14(c)(3)(i) also requires notice and opportunity for public comment. ADEQ's documentation was available on the ADEQ web-site and the ADEQ Library in Phoenix beginning on October 15, 2009. No comments were received from the public during the comment period.[38] Information included in the draft supplemental report, received by EPA on March 17, 2010, has not yet gone through the public comment process.

[36] EER Preamble, 72 FR 13569.
[37] Id. at 13570.
[38] Letter from Nancy Wrona, ADEQ, to Deborah Jordan, USEPA Region 9 received on November 17, 2009.

9.0 Conclusion

ADEQ stated that the measured exceedances at the West 43rd monitoring site, during these days, were a result of the transport of dust from soils by high winds that were associated with approaching low pressure systems. For all of the events, there appears to be elevated wind speeds in various locations throughout the Phoenix area, but as discussed in section 4.3, ADEQ's approach to defining "unusual" winds relies on complete yearly data, rather than the season during which the events occurred. In addition, ADEQ's approach would find that "unusual" winds occur on approximately 100 days a year. Also, there is little discussion or explanation concerning the meteorological conditions that were occurring on the days in question and how those conditions affected the elevated PM_{10} concentrations at the West 43rd monitoring site. The majority of the data concerning these relationships are presented in tables and a small number of graphs with no explanation of the interpretation of the information that has been presented.

Moreover, the Assessments did not adequately address the sources that may have been contributing to the event. Without this information, it is difficult to determine whether the elevated PM_{10} concentrations resulted from controllable anthropogenic sources or natural desert sources. Since there are numerous anthropogenic sources located in upwind areas, this information is critical to assessing whether an exceedance is the result of an exceptional event or uncontrolled anthropogenic sources. With little discussion of the meteorological conditions on the event days combined with a very limited discussion on possible sources, the Assessments did not adequately establish a clear source-receptor relationship or make a convincing demonstration that the events in question should be considered natural events under the EER.

Furthermore, the information in the Assessments did not support the broad conclusion that the elevated PM_{10} concentrations were caused by transport of dust from soils by high winds. Again, without acknowledging the sources that may be contributing to the event, it is difficult to determine where the dust originated from and how it was transported to West 43rd. Also, the monitoring data is inconsistent with the notion of transport. If transport was occurring on these days, one would expect to see similar concentrations at nearby monitoring locations. One of the most interesting aspects of these events is that on March 14 and April 30 the West 43rd monitor is the only monitor to violate the 24-hour standard, not only in the Phoenix area, but the entire state of Arizona except for the Cowtown monitor in Pinal County, which consistently measures the highest levels of PM_{10} within Region 9 due to its proximity to a large cattle feedlot. Also, the differences between the hourly PM_{10} concentrations at West 43rd and other sites that are located just a few miles away are striking. Although it is very clear that there is something unique about the measured exceedances at the West 43rdsite, the assessments did not explain these differences in PM_{10} concentrations and how they are inconsistent with a regional high wind event.

The June 4 DSR included a more detailed discussion of the meteorological conditions during the event and provided some discussion on the sources that may be influencing the elevated PM_{10} concentrations at the West 43rd monitoring site. The additional documentation asserted that the exceedance measured at the West 43rd monitoring site can be attributed to emissions from the dry Gila and Salt River channels that were coupled with contributions from a regional dust storm. As previously discussed, the documentation Assessments did not provide sufficient technical

justification of this conclusion and did not explain how emissions from these sources were not reasonably controllable or preventable. Furthermore, the data show that the contribution from the regional dust storm during the late night hours of June 4 was not significant and the exceedance was most likely driven by the elevated PM_{10} concentrations measured in the late morning and early afternoon hours.

The June 4 DSR provided some new information regarding the significant differences in the hourly PM_{10} values seen at the Durango Complex and South Phoenix monitoring sites. The documentation stated that "it is also entirely possible that the urbanized core of the Phoenix metro area acted to reduce the amount of blowing dust compared to the western periphery due to increased surface roughness." While this might be relevant, it does not account for the nearly identical PM_{10} concentrations measured throughout the entire Phoenix area in the evening hours of June 4 and the morning hours of June 5. The June 4 DSR did not provide sufficient technical analysis to support a clear source receptor relationship or provide new evidence to support the notion that the June 4 event should be considered a natural event under the EER. Considering the weight of available evidence, EPA does not concur that the March 14, April 30, May 21 and June 4, 2008 exceedances at the West 43rd monitoring site should be treated as exceptional events.

Appendix A

Table 1: Meteorological Data Used in ADEQ's Assessments[39]						
Available Met Data	**Distance to West 43rd**	**Direction**	**3.14.08**	**4.30.08**	**5.21.08**	**6.4.08**
WEST PHOENIX	5	N	**x**		**x**	
MESA	16	E		**x**		
NORTH PHOENIX	12	NNE				
GLENDALE	12	N				
PINNACLE PEAK	27	NE				
CENTRAL PHOENIX	7	ENE	**x**	**x**		**x**
SOUTH SCOTTSDALE	14	ENE		**x**		
GREENWOOD	4	NNE				
SOUTH PHOENIX	4	E		**x**	**x**	
COYOTE LAKES*	21	NNW	**x**			**x**
WEST CHANDLER	17	ESE		**x**		
TEMPE	12	E				
HIGLEY	25	ESE		**x**		
WEST 43RD	n/a	n/a	**x**	**x**	**x**	**x**
DYSART	20	NNE				
BUCKEYE	28	W			**x**	**x**
DURANGO COMPLEX	2	NE	**x**	**x**	**x**	**x**
JLG SUPERSITE	7	NNE				
WEST INDIAN ROAD	6	N				
FALCON FIELD	24	E				
CAVE CREEK	29	NNE				
BLUE POINT	32	ENE				
FOUNTAIN HILLS	28	ENE				
GOODYEAR	13	W	**x**	**x**		
LUKE AFB	16	NW				**x**
GLENDALE	13	NW	**x**			
SKY HARBOR	9	ENE	**x**		**x**	
DEER VALLEY	20	N			**x**	
SCOTTSDALE	20	NE				
FALCON FIELD	24	E				
CHANDLER	21	ESE				
WILLIAMS GATEWAY	29	ESE				

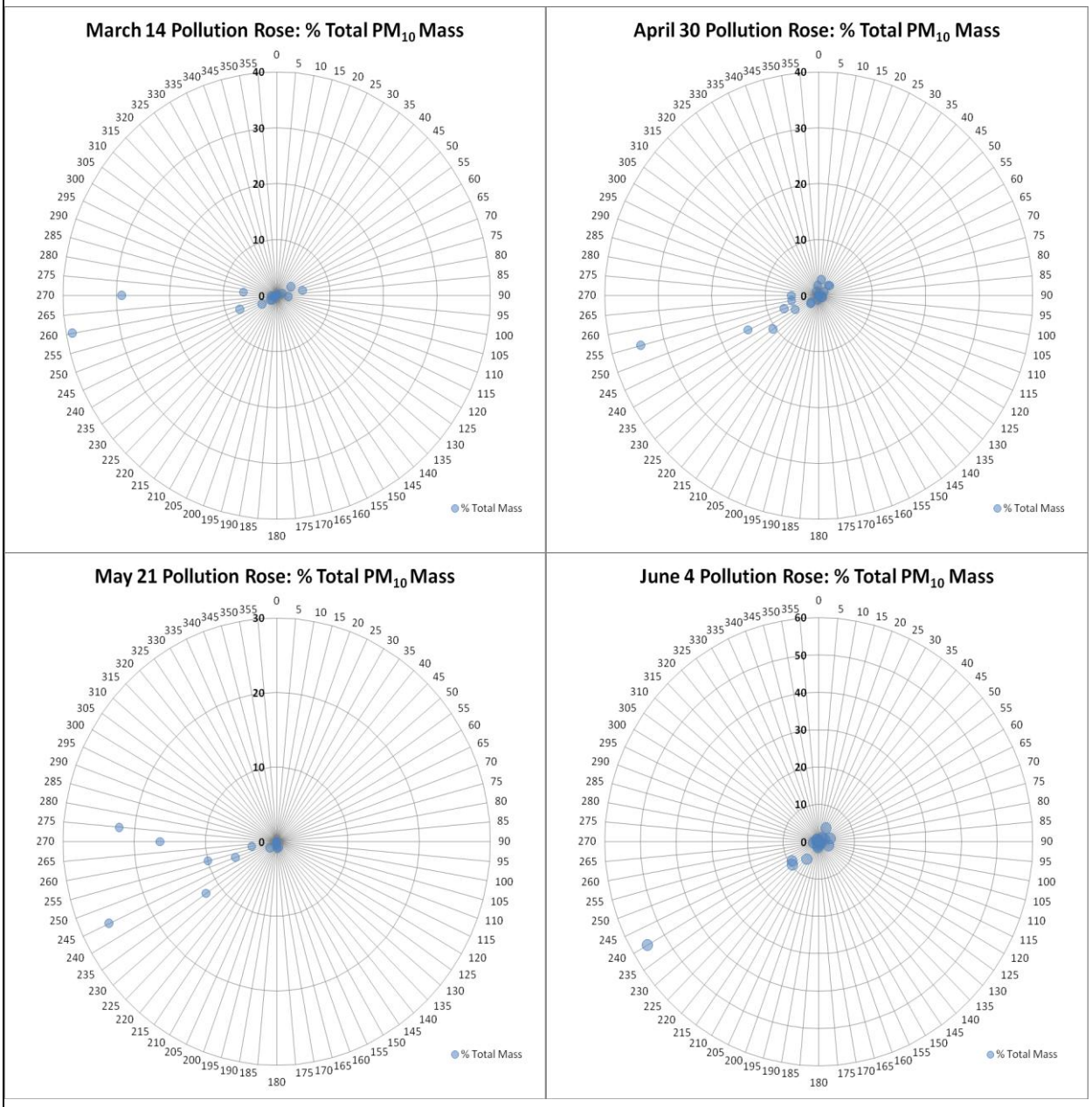
[39] The highlighted areas in Table 1 correspond to either the closest meteorological station or stations upwind of the West 43rd monitoring site.

Table 2: PM_{10} Data Used in ADEQ's Assessments[40]				
Site Name	**Distance to West 43rd**	**Direction**	**24 Hour PM_{10} Data**	**Hourly PM_{10} Data**
3.14.08				
WEST PHOENIX	5	N	**x**	**x**
CENTRAL PHOENIX	7	ENE	**x**	**x**
GREENWOOD	4	NNE	**x**	**x**
SOUTH PHOENIX	4	E	**x**	
COYOTE LAKES	21	NNW	**x**	**x**
HIGLEY	25	ESE	**x**	
WEST 43RD	n/a	n/a	**x**	**x**
BUCKEYE	28	W		
DURANGO COMPLEX	2	NE	**x**	**x**
JLG SUPERSITE	7	NNE	**x**	
4.30.08				
WEST PHOENIX	5	N	**x**	
MESA	16	E		**n/a**
NORTH PHOENIX	12	NNE		**n/a**
GLENDALE	12	N		**n/a**
CENTRAL PHOENIX	7	ENE	**x**	**x**
SOUTH SCOTTSDALE	14	ENE		**n/a**
GREENWOOD	4	NNE	**x**	**x**
SOUTH PHOENIX	4	E	**x**	**x**
COYOTE LAKES	21	NNW	**x**	
WEST CHANDLER	17	ESE		**n/a**
HIGLEY	25	ESE	**x**	**x**
WEST 43RD	n/a	n/a	**x**	**x**
DYSART	20	NNE		**n/a**
BUCKEYE	28	W		
BETHUNE	4	NE		**n/a**
DURANGO COMPLEX	2	NE	**x**	**x**
JLG SUPERSITE	7	NNE	**x**	
5.21.08				
WEST PHOENIX	5	N		**x**
CENTRAL PHOENIX	7	ENE		
GREENWOOD	4	NNE	**x**	
SOUTH PHOENIX	4	E	**x**	**x**
COYOTE LAKES	21	NNW		
HIGLEY	25	ESE		
WEST 43RD	n/a	n/a	**x**	**x**
BUCKEYE	28	W		**x**
BETHUNE	4	NE		**n/a**
DURANGO COMPLEX	2	NE	**x**	**x**
JLG SUPERSITE	7	NNE		

[40] The highlighted areas in Table 1 correspond to either the closest meteorological station or stations upwind of the West 43rd monitoring site.

6.4.08				
WEST PHOENIX	5	N		**x**
CENTRAL PHOENIX	7	ENE		**x**
GREENWOOD	4	NNE		**x**
SOUTH PHOENIX	4	E		
COYOTE LAKES	21	NNW	**x**	**x**
HIGLEY	25	ESE		
WEST 43RD	n/a	n/a	**x**	**x**
BUCKEYE	28	W	**x**	**x**
BETHUNE	4	NE		
DURANGO COMPLEX	2	NE		**x**
JLG SUPERSITE	7	NNE		

Figure 1: West 43rd Pollution Roses % Total PM_{10} Mass



Appendix B

EPA acknowledges that massive dust storms do occur in the Southwestern United States and that these events could quality as exceptional events if all requirements of the EER were satisfied. The following information could be used as evidence in an exceptional events demonstration if the conditions of the event were consistent with those observed during a dust storm.

The relationship between weather types, wind speed, and dust storm generation has been researched and examined for many years. Generally, there are generally four different weather types that are capable of producing dust storms. These conditions were examined in further detail by Brazel and Nickling in two separate research papers during the 1980's. Both studies conclude that the frequency of dust storms can be directly linked to specific weather conditions which are accompanied by elevated wind speeds, but also note that dust events are "strongly affected by antecedent conditions (i.e. surface moisture, vegetation cover, surface crusting, and anthropogenic disturbances)". For the years 1965 -1980, 80% of all intense dust storms[41] in the Phoenix area were related to thunderstorm activity in the region. The mean wind speed for dust storms during this time period in the Phoenix area were 12.4 m/s or 27.7 mph, while the mean peak gusts were 17.8 m/s or 39.8 mph (Nickling W.G., Brazel A.J., 1984). Some of these intense dust storms that occur in the Phoenix area could potentially be classified as "haboobs": events that are caused by powerful downdrafts from thunderstorms and have the potential to create solid walls of advancing dust (Idso, 1972).

There are a number of different definitions of "dust storms" based on different levels of reduced visibility. The National Weather Service issues a dust storm advisory when visibility drops below 1 mile and a dust storm warning when visibility is less than ¼ mile. NWS further states that "typically, Blowing Dust Advisories are issued for widespread winds that may produce localized areas of blowing dust" and "dust storms can occur with widespread winds, or may be associated with thunderstorm outflow." Table 2 lists all days in 2008 that had reports of blowing dust or dust storms at Phoenix NWS stations.

Similarly, Nickling and Brazel (1984) also use a reduced visibility of 1 mile as a cut-off point for dust storm classification. This criterion was chosen to be the most representative of the conditions that can be attributed to dust storms in Arizona. Earlier research suggests that reduced visibility less than 7 miles constitutes dust storm classification (Orgill, Sehmel, 1976). Table 1 shows the visibility recorded at Goodyear Airport during the event days in question compared to the various dust storm definitions discussed above.

In 2008, the Phoenix area experienced numerous occurrences of thunderstorm activity and elevated winds. A detailed account of these events is displayed in table 3 and is available in the NWS report "Storm Data and Unusual Weather Phenomena". Four of the events are described as dust storms.[42] For example, an event occurring on September 11 was described as "a

[41] Intense dust storms (IDS) correspond with visibility ≤ 1 mile, while moderate-to-weak dust storms (MWDS) correspond to visibility >1 mile but ≤ 7 miles.

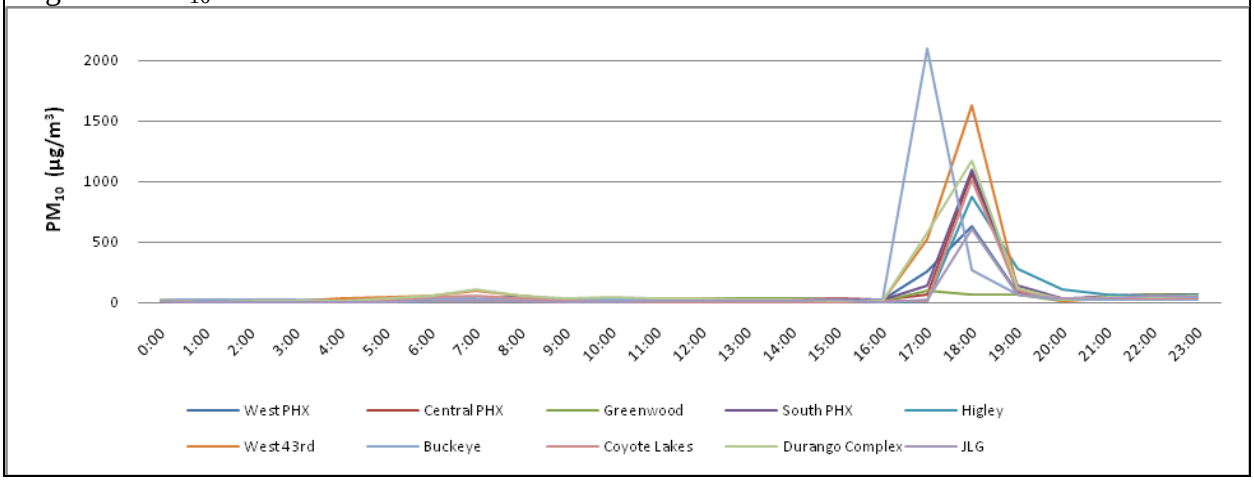
[42] The events described by the NWS as dust storms occurred on May 15, July 1, July 10, and September 9. The meteorological events that occurred on the days of concern for the present analysis (March 14, April 30, May 21, and June 4) were not characterized as such.

spectacular dust storm moved across west-central and central Maricopa County, including the Greater Phoenix area. Dust moved southwest to northeast, with winds typically 30-50 mph accompanying the blowing dust. A 3-mile stretch of power poles was blown down along old U.S. highway 80 south of Buckeye and north of Gila Bend (615 PM)".

Table 1: Dust Storm Comparison				
Event Date	**3.14.08**	**4.30.08**	**5.21.08**	**6.4.08**
Event Visibility (miles)[43]	**10**	**7**	**7**	**20**
0.25[44]	N	N	N	N
1[45]	N	N	N	N
7[46]	N	N	N	N

Figure 1 further illustrates how PM_{10} concentrations can be affected during these events. The September 9 dust storm originated in the southwest and moved through Phoenix, heading northeast. Wind speeds throughout the Phoenix area reached 30 mph, with 40 mph wind gusts reported at the NWS Luke Air Force Base station. Wind direction during the event was predominately from the west/southwest. The visibility during the event dropped below ¼ mile at one station and remained below 5 miles for other stations in the area. Figure 1 shows the west to east movement of the dust storm and its effect on the PM_{10} monitoring stations in the Phoenix area. PM_{10} concentrations spike first at the Buckeye monitor at 1700 hrs and the rest of the central Phoenix area experiences elevated PM_{10} concentrations at 1800 hrs.

Figure 1: PM_{10} concentrations 9/11/08



[43] Visibility during periods of elevated wind speed and elevated PM_{10} at West 43rd
[44] NWS Warning
[45] NWS Advisory & Nickling and Brazel
[46] Orgill and Sehmel

Table 2: National Weather Service Significant Weather Types 2008									
Date	**Goodyear**	**Luke AFB**	**Glendale**	**Sky Harbor**	**Chandler**	**Williams Gateway**	**Falcon Field**	**Scottsdale**	**Deer Valley**
3.14.08									
4.16.08	BLDU								
4.30.08									
5.15.08	BLDU	SQ			BLDU				
5.21.08					BLDU				
6.4.08	BLDU	BLDU DU							
6.5.08		HZ		BLDU HZ	BLDU	HZ		HZ	HZ
7.1.08		BLDU			BLDU				HZ SQ
7.3.08		BLDU							
7.4.08			BLDU					HZ	
7.10.08				BLDU					
7.13.08				BLDU					
7.26.08						BLDU			
8.7.08		BLDU		BLDU	BLDU				
8.14.08	BLDU	BLDU		BLDU	BLDU	BLDU			
8.25.08	BLDU	BLDU SQ	BLDU	BLDU					
8.30.08		BLDU			BLDU				
9.8.08					BLDU				
9.11.08	DS	BLDU HZ	BLDU	BLDU HZ SQ	BLDU	DS HZ	BLDU	HZ SQ	HZ
9.26.08						BLDU			
9.27.08				BLDU					
11.9.08	BLDU	HZ		BLDU	BLDU		BLDU		HZ
12.13.08	BLDU								
Notes: BLDU - Blowing Dust DS - Dust Storm DU - Dust HZ - Haze SQ – Squall[47]									

Table 3: NWS Storm Data and Unusual Weather Phenomena Reports 2008				
Date	**Location[48]**	**Event**	**Time**	**Description**
3.14.08	**NONE**			
4.16.08	**NONE**			
4.30.08	**NONE**			
5.15.08	AZZ028-Central Deserts	**Dust Storm**	1515-1640	Strong and gusty winds uprooted trees in Eastern Chandler. **Dense blowing dust** with low visibility was reported at Gateway airport
	Maricopa County	Thunderstorm Wind	1535-1610	Portions of eastern Maricopa county and Pinal county received gusty winds from a line of thunderstorms that moved rapidly toward the south.
5.21.08	NONE			

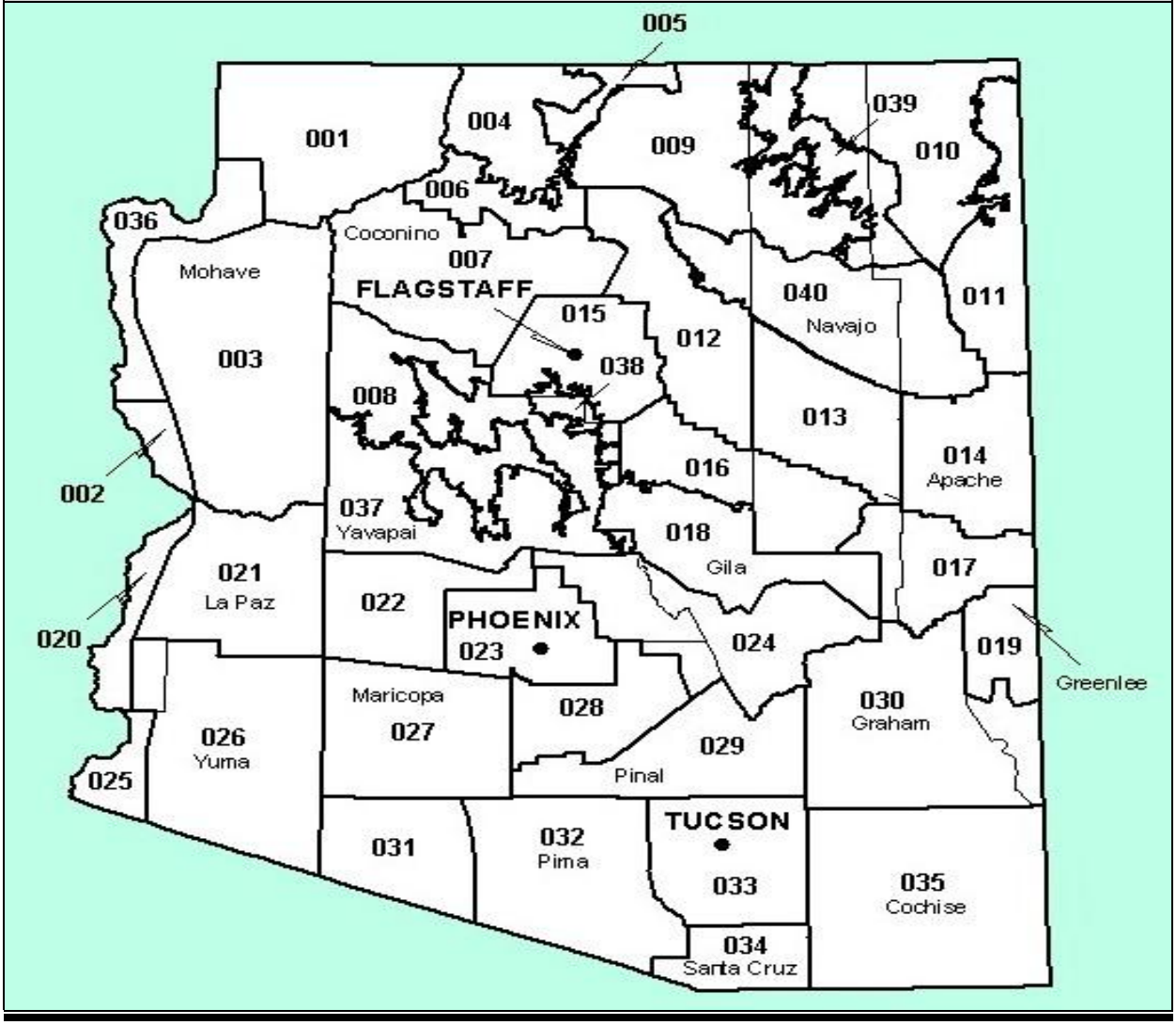
[47] NWS definition: sudden onset of a strong wind with increase of at least 16 knots and sustained at 22 knots or more for at least one minute

[48] See Figure 2 for NWS Forecast Areas

6.4.08	**NONE**			
6.5.08	NONE			
7.1.08	AZZ028-Central Deserts	**Dust Storm**	1740-1800	Low visibility due to blowing dust resulted from strong winds from nearby thunderstorms. Winds were generally in the 30 to 40 mph range with reports of **blowing dust** in the Phoenix East Valley Late in the afternoon and early afternoon.
7.3.08	Maricopa County	Funnel Cloud	2140	Pilot reported sighting a brief funnel cloud. Thunderstorms were triggered by an old outflow boundary. The associated peak wind gusts were 28 knots at Sky Harbor and 39 knots at Scottsdale airport
	Pinal County	Thunderstorm Wind	1630-1631	Several trees were uprooted at Saddlebrook
7.4.08	Maricopa County	Thunderstorm Wind	1900-2000	Scottsdale airport recorded peak winds of 53 mph during thunderstorms. Winds at Sky Harbor airport reached as high as 39 mph and some tents at the fireworks display were blown down
7.10.08	AZZ026 - Southwestern Deserts	**Dust Storm**	1540-1700	Strong winds from nearby thunderstorms resulted in **dense blowing dust**.
	Maricopa County	Thunderstorm Wind	1830-2045	Winds caused power outages and property damage due to microburst winds as high as 65 mph. Winds blew down a tree near 78th Street and McDonald which damaged a covered parking structure.
	Maricopa County	Thunderstorm Wind	1915-1925	Winds speed measured at 68 mph at Bush Highway and Usery Pass Road. According to radar, these storms were moving west at about 35 mph.
	Pinal County	Thunderstorm Wind	1927-1940	Spotters in two locations in Apache Junction had gusts to 67 and 89 mph
7.13.08	Maricopa County	Thunderstorm Wind	1600-1630	Winds from a microburst blew down about 25 trees and damaged light poles at Mesa Community College. A security officer was slightly injured when the strong winds blew him from his golf cart.
7.26.08	Maricopa County	Thunderstorm Wind	1830	Power poles and trees were reported down at Chandler Heights and Greenfield roads, as well as Ocotillo and Higley and at Ocotillo and Power roads. Brief strong winds caused isolated damage to parts of the Southeast Valley
8.7.08	Maricopa County	Thunderstorm Wind	1940-1950	Power poles and lines reported blown down. As many as 70 poles were down in the Buckeye area alone. Note: the estimated wind gust of 60 knots is equivalent to 69 mph.
	Maricopa County	Thunderstorm Wind	2017-2020	Power poles down in Central Phoenix. Note: the estimated wind gust of 60 knots is equivalent to 69 mph.
	Maricopa County	Thunderstorm Wind	2020-2025	Large branches blown from trees. Note: the estimated wind gust of 55 knots is equivalent to 63 mph.
8.14.08	Pinal County	Thunderstorm Wind	1810-1850	Strong winds reported by spotter. Note: the estimated wind gust of 52 knots is equivalent to 60 mph.

	Maricopa County	Thunderstorm Wind	1812-1852	Several crashes on the Loop 202 were blamed on strong winds and rain. Power outages were reported after winds and rain moved through the East Valley. SRP reported about 3,000 customers were left without electricity…and APS reported 2,000 customers without power. Note: the estimated wind gust of 52 knots is equivalent to 60 mph.
	Maricopa County	Thunderstorm Wind	1838	Strong winds reported at Brown and Mesa. Trees were damaged. Note: the estimated wind gust of 50 knots is equivalent to 58 mph.
	Maricopa County	Thunderstorm Wind	1905	Winds at Chandler Airport reached 50 knots as severe thunderstorms moved toward the west. The southern and central portions of Arizona were very moist and unstable. Storms developed and moved toward the southwest and strong winds kicked up widespread areas of **blowing dust**. A Severe Thunderstorm Watch was in effect for much of the evening. Note: the measured wind gust of 50 knots is equivalent to 58 mph.
8.25.08	Maricopa County	Thunderstorm Wind	1510-1526	Microburst winds hit Chandler airport and flipped at least two planes. Winds also damaged a fence and other property. Northeast winds peaked at 67 mph at 3:25 pm. Thunderstorm winds over 80 mph damaged planes at Chandler Municipal Airport. Strong winds also blew down tress and damaged some homes in the Chandler area. **Dense blowing dust** was also reported. Note: the measured wind gust of 58 knots is equivalent to 67 mph.
8.30.08	NONE			
9.8.08	NONE			
9.11.08	Maricopa County	Thunderstorm Wind	1710-1720	Shingles were blown off homes, and a few trees were uprooted.
	Maricopa County	Thunderstorm Wind	1734-1742	Winds estimated to reach as high as 60 mph along with visibility to less than a 1/4 mile in **blowing dust**.
	Maricopa County	Thunderstorm Wind	1740	Flood control district sensor measured a gust to 60 mph.
	AZZ023-Greater Phoenix Area	**Dust Storm**	1745-1815	Thunderstorms moved steadily toward the northeast during afternoon hours. As a result, locally heavy rain, strong winds and very low visibility due to **dust and sand moved across the deserts**
	Maricopa County	Thunderstorm Wind	1815-1840	According to Arizona Public Service, 48 power poles across a distance of three miles were blown down along Old Highway 80 between Buckeye and Gila Bend. Winds were measured up to 56 mph on the Palo Verde Nuclear Generating Station tower.
9.26.08	NONE			
9.27.08	NONE			
11.9.08	NONE			
12.13.08	NONE			

Figure 2: NWS Forecast Areas



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